SIZE OF INDIVIDUAL CONTACTS IN SLIDING FRICTION

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by

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at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ABSTRACT

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by

John Allan Seward, Jr.

Robert Blake Hayman

Submitted to the Department of Naval Architecture and Marine Engineering on May 21, 1956 in partial fulfillment of the requirements for the degree of Naval Engineer.

The object of this investigation was to determine the size of individual contacts in sliding friction by electronically measuring the duration of individual contacts. To accomplish this, a fine insulated tungsten wire and three heavier tungsten wires were imbedded in a glass probe which was ground so that the ends of the tungsten wires were exposed and formed a plane. A plane surface of 1045 steel was rotated beneath, and supported the probe which was held stationary by a pivoted rider arm. The duration of contacts between the fine insulated tungsten wire and the 1045 steel plate was measured electronically by a Sanborn recorder.

Calculations showed that the diameter of the average contact area occuring in sliding friction has an order of magnitude between 2×10^{-4} cm and 6×10^{-4} cm. Most of the contact areas have diameters much smaller than the diameter of the average contact area. The size distribution of the contact areas is such that the log of the number of contacts bears a linear relationship to the log of the average area for intervals of equal area.

Further investigation is required to determine the effect of contact deformation, relative velocity, surface finish and loading on the size of individual contacts in sliding friction.

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I. INTRODUCTION

Traditionally, the most satisfactory method for treating the subject of friction has been by the use of experimentally determined coefficients.

In expressions like the following one for total shear force

$$F_s = \tau A$$

neither τ nor A is known with precision. τ in fact, may vary considerably from one individual metallic contact to another. Thus A is really nothing more than a fictitious apparent area which may or may not be the same as the true area of contact. In handling most practical situations, it is not necessary to know these quantities exactly. However, if the mechanism of friction is to be more completely explained, it seems reasonable to suppose that a great deal more information concerning the size and distribution of the individual metallic contacts must be obtained.

Several methods for investigating the true area of contact between metallic surfaces have been devised.

Holm[1] estimated the true contact area by the measurement of electrical resistance. There are some rather severe restrictions which limit the validity of this approach, the unpredictable constriction effect upon the accuracy of the resistance measurements as a true in-

1. INTRODUCTION

dication of the area in contact and the effect of oxide film to name but two. At best this gives only a rough indication of the true over all contact area. It is impossible to interpret the results in terms of the individual contacts.

Dyson and Hirst[4] were able to draw several interesting conclusions from their work.

a) Surface finish affects the distribution of the areas of contact.

b) An increase in the loading increases the number of the groups of individual contacts but not their size. The size of the groups was estimated as about .2 mm for the pattern produced by pressing a silver steel plate against a silver coated piece of glass.

c) Only a very small part of the metallic surface is in contact.

Here again, the method is not suitable for the determination of the individual contact areas. Also it gives a representation of the static picture only and the degree to which this can be taken as an indication of the dynamic picture is not known.

I-Ming Feng[8] has studied the surface characteristics of metals and reports the dimensions of the scratches produced by diamond dust (0 to .5 micron) to be of the order of .01 to .05 microns. One micron = 10^{-4}cm.

E. Rabinowicz has proposed three interesting though somewhat indirect methods for estimating the average diameter of the individual contacts.

1. As part of his investigation of the static and kinetic coefficients of friction, Rabinowicz[2] predicts an average contact diameter of about 7×10^{-4}cm for copper on steel.
2. Rabinowicz and Tabor[3] estimate the average weight of transfer particles produced by the sliding motion between metallic surfaces to be about 10^{-5}grams. By assuming a simple hemispherical model, Rabinowicz[2] computed an average diameter of about 17×10^{-4}cm for the individual contacts.
3. The most recent method used by Rabinowicz[6] to predict the average diameter of the individual contact area comes as the result of the application of the auto-correlation analysis of sliding friction. The diameter obtained by this method is in the order of 10^{-3}cm.

The work of this present investigation represents an attempt to determine the magnitude of the average contact diameter in a much more direct manner. The time that a very fine tungsten wire imbedded in glass (Fig. 4) remains in contact with the surface imperfections as it moves relative to the face of a steel plate may be re-

corded electronically by a Sanborn recorder. The problem which remains is essentially that of relating this measured contact duration to the individual area of contact.

II. PROCEDURE

The apparatus used to determine the size of individual contact areas in sliding friction is shown in Figures 1, 2, and 3. Figure 1 is an overall view of the experimental set up. Figure 2 is a closer side view of the inverted drill press. Figure 3 is a close up showing in detail the mounting of the glass probe and steel plate.

A variable speed gear drive is used to turn the spindle of the inverted drill press. The flat plate specimen of 1045 steel is secured to a circular mounting block which is held in the drill chuck. The steel plate rotates beneath and supports the glass probe containing a fine tungsten contact wire. The glass probe is held stationary by a rider arm mounted on a platform which is clamped to the drill column. The rider arm is pivoted about a horizontal axis and balanced to permit the application of any desired total load. The steel plate is insulated from the mounting block and connected by wire to one side of a resistance bridge. The fine tungsten contact wire in the glass probe is connected to the other side of the bridge. The resistance bridge is connected to the Sanborn recorder so that contact between the steel plate and the tungsten contact wire can be recorded on tape.

The steel plate was rotated at speeds ranging

The exercises need to demonstrate the size of the different concepts around to digital logic. Figure 1 is an example of the characteristic set up. Figure 2 is a close-up view of the clearing magic power. Figure 3 is a close up of something of the inverted magic power. Figure 4 is a close up of the clearing magic power.

A particle speed time limit is used to make the polarity of the inverted magic power. The flag state monitors of this power is changed to a physical manufacturing of this power to a physical manufacturing. The user plate points a time monitored monitor wire. The clear plate is only electronic in a wider bus monitored as a timeline mixed to simplex to the cyril network. The wire can be viewed about a monitored unit monitored to determine the exploration of any inverted metal line. The wire light is inverted from the monitor plate and monitor of wire to one side of a polarizing motion. The clear inverted monitor wire in the clear phase is monitored to the other side of the bridge. The resistance bridge is connected by the constant inverter as just discover the wire light side and the location control wire was in standing no more.

from .015 to .055 RPM. These low speeds were obtained by using a belt drive pulley system in conjunction with the variable speed gear drive. The lowest steady rotational speed which could be maintained by the variable speed gear drive with the pulley combination used was .015 RPM. The highest speed of rotation which still permitted distinguishing between the traces of individual contacts was about .055 RPM. Speed of rotation was measured by counting the circumferential distance which the rotating circular mounting block traveled with respect to a fixed pointer during one minute. Dividing this circumferential distance by the total circumference of the circular mounting block gave the speed of rotation in RP M.

A sketch of the glass probe is shown in Figure 4. The three relatively large diameter tungsten wires were undercut sufficiently to permit the fine tungsten contact wire to act as a high spot on that plane. Attaining the proper amount of undercutting to obtain intermittant contact between the tungsten contact wire and the steel plate was a trial process which took considerable time and patience. Two representative tape traces which show intermittant contact are given in Figure 5. For both traces the arrows beneath the traces point out the start of contact and the arrows above the traces point out the end of contact. The duration of a single contact is proportional to

the tape distance between the lines of action of any one lower arrow and the first upper arrow to the right of that lower arrow.

While measuring the size of individual contacts in sliding friction, it was decided to attempt to determine the effect of three variables:

1. Surface finish
2. Relative velocity (speed of rotation)
3. Load

To do this three sets of data were taken. Each set consisted of taking from five to seven tape recordings for a given surface finish, a given speed of rotation, and a range of loads (one tape for each load). For the first two sets of data the steel plate was finished with 2/0 emery paper. For the third set of data the steel plate was finished with #1 emery paper. In all cases the probe was undercut and finished with 2/0 emery paper. The first two sets of data were taken at the maximum difference in the speeds of rotation. The tabulated data for each of the 17 tape recordings is given in Appendix B.

In order to analyze the recorded data the following assumptions were made:

1. There is a single high spot on the probe contact wire.
2. The high spots on the steel plate and the high spot on the probe contact wire have spherical

surfaces with the same radius of curvature.

3. The effect of the limited size of the probe contact wire high spot is negligible.
4. The effect of the deformation of the two high spots during their mutual crossing is negligible.

With these assumptions it follows that during the crossing the maximum area in contact is circular with a diameter equal to one half of the tape contact distance times the crossing speed divided by the tape speed. That is:

$$\text{Contact diameter} = \frac{(\text{tape distance})(\text{crossing speed})}{2(\text{tape speed})} \qquad (1)$$

Therefore, we have defined contact area as the maximum area in contact between two high spots during their mutual crossing.

The average of the contact diameters for each tape was computed by dividing the sum of the tape distance by the number of contacts and converting to contact diameter by equation (1).

The diameter of the average contact area for each tape was calculated using a statistical method to obtain the average tape distance squared and then, after taking the square root, converting to contact diameter by using equation (1).

The statistical method can best be explained by referring to Table XXI. Twenty evenly spaced intervals of tape distance squared were used. In addition, the first interval was further broken down into ten evenly spaced intervals of distance squared. This additional breakdown was used to determine a more accurate mean value of tape distance squared for the first interval. The mean value of tape distance squared for all other intervals is defined as the average of the extreme tape distances squared for that interval. For all tapes the spacing of the intervals was such that the mean value of the tape distance squared for any one interval represented the same contact area for all tapes. Each of the few contact durations which did not fall within the twenty intervals was used as though it was the mean value of an interval containing that one contact duration.

III. RESULTS

The results of this investigation are given in Tables I and XX and in Figures 6, 7, and 8. The average diameter of the contact areas for each tape ranged from 1.16×10^{-4}cm to 3.77×10^{-4}cm. The diameter of the average area ranged from 1.93×10^{-4}cm to 5.90×10^{-4}cm.

Figure 6 shows the effect of relative velocity, loading, and surface finish on the average diameter of the contacts and on the diameter of the average contact area. The effect of these three variables is the same on both these diameters. Decreasing relative velocity decreases these diameters. Increasing loading with the 2/0 surface finish decreases these diameters. The coarser #1 surface finish tends to make the size of these diameters independent of loading.

The total number of contacts tabulated in Tables II through XIX is 3,169. Table XX shows that for these total contacts

2,893 have individual contact areas less than 292×10^{-8}cm^2
2,524 have individual contact areas less than 14.6×10^{-8}cm^2
1,558 have individual contact areas less than 1.46×10^{-8}cm^2

This means that 80% of the contacts have diameters less than 4.3×10^{-4}cm, and about 50% of the contacts have diameters less than 1.4×10^{-4}cm. This size distribution of contact areas is given in Figures 7 and 8. These plots

XII. [illegible]

show that a straight line relationship exists between the log of the number of contacts and the log of the average area for intervals of equal area.

IV. DISCUSSION OF RESULTS

The accuracy of the diameter calculations depends primarily upon the relation between the measured contact duration and the contact area. Equation (1) is exact, and therefore the calculated diameters are correct, provided that the assumptions given in the procedure are exact. Therefore, each assumption will be examined to determine its validity.

Assumption 1: <u>There is a single high spot on the probe contact wire</u>. An attempt was made to insure the exactness of this assumption by making the exposed end of contact wire as small as possible. The exposed end of the probe contact wire was an ellipse with the following measurements:

$$\text{major axis} = 5.2 \times 10^{-4}\text{cm}$$

$$\text{minor axis} = 4.3 \times 10^{-4}\text{cm}$$

This shows that the mean diameter of the exposed end of the probe contact wire is of the same order of magnitude as the diameter of the average contact area. Therefore, it is improbable that there is more than one high spot on the probe contact wire. Hence we can say that assumption 1 is probably exact.

Assumption 2: <u>The high spots on the steel plate and the high spot on the probe contact wire have spherical surfaces with the same radius of curvature</u>. Most previous

12. Dimensions of concrete

The economy of the Chinese civilization depends primarily upon the relation between the measured content therefore and the content area. Assuming [1] is exact, and therefore the calculated elsewhere are correct, analyses that the assumptions given to the temperature are exact.

Therefore, zero assumption will be required to determine its validity.

Assumption 1: There is a single drop on the right hand side.

Large volume area. To estimate the economics of this assumption by testing the existence and of the coastal wire is small as possible. The reduced mod of the large coastal wire may be written with the following approximate:

$$\text{minor ratio} = 6.1 \times 10^{-9}\text{m}$$

$$\text{major ratio} = 5.5 \times 10^{-9}\text{m}$$

This above fits the open element of the exposed mod of the large coastal wire is of the same order of magnitude as the diameter of the atomic coated item. Therefore, it is impossible that there is more than one drop mod on it is procedure above.

Assumption 2: The drop ratio on the exact side and the drop mod on the large coastal wire have similar mass. Good measure there will be some region of deviation.

investigators have used either hemispherical models or circular models for their investigation of contact area sizes. Therefore, it is felt that the assumption of spherical surfaces is a valid one provided that the plate surface is properly finished. To minimize the possibility of ridge shaped contact areas the plate surface was finished in two perpendicular directions. The effect of differences in the radii of curvature of the mutually crossing high spots upon the relation between contact duration and contact area will be negligible if the radii of curvature are large. According to previous investigations the angle of rise of the high spots is small. This means large radii of curvature of the spherical surfaces of the high spots. Consequently the effect of differences in radii of curvature on the relations between contact duration and contact area is negligible. Theoretically, while assumption 2 must be true for equation (1) to be exact, actually, the differences in radii of curvature have a negligible effect on the calculated values of contact diameters.

Assumption 3: <u>The effect of the limited size of the probe contact wire high spot is negligible</u>. The maximum area in contact during a crossing is actually limited to the area of the end of the probe contact wire. This area is about $17.7 \times 10^{-5} cm^2$. Approximately 20% of the total number of the contacts have contact areas which are greater. We are actually interested in measuring the contact area

which would exist if the size of the probe contact wire high spot was not limited. The fact that the contact wire size is so small means that the larger 20% of diameters calculated using equation (1) would be smaller than the diameters that we are interested in calculating. The larger 20% of the contact durations add considerably to the size of the calculated average diameter of contact and the calculated diameter of the average area. Therefore, the limited size of the probe probably has a significant effect on these two calculated averages.

Assumption 4: The effect of the deformation of the two high spots during their mutual crossing is negligible. The hard tungsten probe contact wire will resist deformation. Hence the deformation will be limited to the 1045 steel plate. Limiting the deformation to one high spot will reduce the effect of deformation on contact durations. The effect of any deformation which does take place will be to increase the contact duration. This would cause the calculations to predict larger contact sizes than actually exist. Whether or not the effect of deformation on contact duration introduces significant error into the calculations is not known.

In order better to evaluate the significance of the calculated sizes of the contacts it is recommended that further investigation be made to determine the effect of the deformation of contacts on the contact durations. Nevertheless we can say that equation (1) gives an order of magni-

tude approximation of the contact diameter. Therefore, we conclude that:

1. The average of the diameters of individual contact areas has an order of magnitude between 1 x 10^{-4}cm and 4 x 10^{-4}cm.
2. The diameter of the average area of the individual contact areas has an order of magnitude between 2 x 10^{-4}cm and 6 x 10^{-4}cm.

It is obvious from the scatter of the data plotted in Figure 6 that the exact effects of the relative velocity, surface finish, and loading on the size of contact areas have not been determined. Therefore, it is recommended that further investigation be made to determine the effect of variables such as these on the size of contact areas. These plots do show general trends of the effects of relative velocity, surface finish, and loading on the size of contact areas. Therefore, we conclude that:

1. Increasing the relative velocity of the surfaces in contact probably increases the size of individual contact in sliding friction.
2. Increasing the loading probably decreases the size of individual contacts in sliding friction for surfaces finished with 2/0 emery paper.
3. Increasing the roughness of the surface finish probably tends to eliminate the effect of loading on the size of individual contact in sliding friction.

[illegible]

[illegible] of the size of [illegible] boundary is still
[illegible] of the size of [illegible] boundary is still
[illegible] of the size of [illegible] boundary is still

Figures 7 and 8 show the size distribution of contact areas. The solid line in Figure 7 is a plot of the number of contacts in each of twenty even area intervals versus the mean area of each interval. In the intervals which contain large area contacts the ratio of the mean area of the interval to the average diameter of the interval is relatively close to unity. In the intervals which contain the small area contacts the ratio may be much greater than unity. Therefore, the solid line in Figure 7 is not a true representation of the size distribution of contact areas since the mean areas plotted for the intervals containing the small contact areas are considerably larger than the average area of the contacts in those intervals. The average area of the first of the twenty intervals was calculated by breaking that interval into ten evenly spaced area intervals and statistically computing the average area for the first interval. This results in the plotted point indicated by the arrow in Figure 7. Since the ratio of mean area to average contact area approaches unity as the intervals containing the larger contact areas are approached, it is postulated that the result of plotting the number of contacts in each interval versus the average contact area for each interval would be the dashed line in Figure 7. This postulation is corroborated by the plot of the size distribution of the contact areas in the first interval which is given in

Figure 8. The slope of the straight line plot in Figure 8 is equal to the slope of the dashed line plot in Figure 7. The mean area was used as the basis for this plot. However, since the area intervals are much smaller in this case, the ratio of mean area to average contact area for all intervals will be much closer to unity. Therefore, the plot given in Figure 8 is a good representation of the size distribution of contact areas.

We conclude that the distribution of contact areas is such that the log of the number of contacts bears a straight line relationship to the log of the average area for intervals of equal areas. Table XX shows the contact area distribution for all tapes. From Table XX we conclude that:

1. About 80% of the contact areas have diameters less than 4.3×10^{-5}cm.
2. About 50% of the contact areas have diameters less than 1.4×10^{-5}cm.

It is recommended that further statistical analysis of the tabulated data should be made for the purpose of explaining the size distribution of the contact areas.

V. CONCLUSIONS

1. The average of the diameters of individual contact areas has an order of magnitude between 1×10^{-4}cm and 4×10^{-4}cm.

2. The diameter of the average area of the individual contact areas has an order of magnitude between 2×10^{-4}cm and 6×10^{-4}cm.

3. Increasing the relative velocity of the surfaces in contact probably increases the size of individual contacts in sliding friction.

4. Increasing the loading probably decreases the size of individual contacts in sliding friction for surfaces finished with 2/0 emery paper.

5. Increasing the roughness of the surface finish probably tends to eliminate the effect of loading on the size of individual contacts in sliding friction.

6. The distribution of contact areas is such that the log of the number of contacts bears a straight line relationship to the log of the average area for intervals of equal area.

7. About 80% of the contact areas have diameters less than 4.3×10^{-5}cm.

8. About 50% of the contact areas have diameters less than 1.4×10^{-5}cm.

7. CONCLUSIONS

1. The average of the diameters of individual nodules never does go under of parallels between 2×10^{-3}cm and 4×10^{-3}cm.

2. The diameter of the erosion area of the individual contact areas has an order of magnitude between 5×10^{-4}cm and 5×10^{-3}cm.

3. Increasing the relative velocity of the surfaces in contact gradually increases the size of individual contacts in sliding friction.

4. Increasing the loading gradually decreases the area of individual contacts in sliding friction (as measured with $1/0$ unit).

5. Increasing the roughness of the surface finish gradually tends to minimize the effect of loading on the area of individual contacts in sliding friction.

6. The distribution of contact area is such that the log of the number of contacts tends to diminish continuously in the log of the change from the individual of equal area.

7. About 50% of the contact areas have diameters less than 1.7×10^{-3}cm.

8. About 50% of the contact areas have diameters less than 1.4×10^{-3}cm.

VI. RECOMMENDATIONS

1. Further investigation should be made to determine the effect of the deformation of contacts on the contact durations.

2. Further investigation should be made to determine the effect of variables such as relative velocity, surface finish, and loading on the size of individual contacts in sliding friction.

3. Further statistical analysis of the tabulated data should be made for the purpose of explaining the size distribution of the contact areas.

17. Conclusions

VII. APPENDIX

APPENDIX A

Pictures of Experimental Set Up and Sketch of Probe

Page

Figure 1. Picture, Over All Experimental Set Up ... A 2

Figure 2. Picture, Side View of Wear Machine ..... A 3

Figure 3. Picture, Close Up of Mounted Probe ..... A 4

Figure 4. Sketch of Probe ..... A 5

Figure 4. Design of Piston 4-5

Figure I
Over All Experimental Set Up

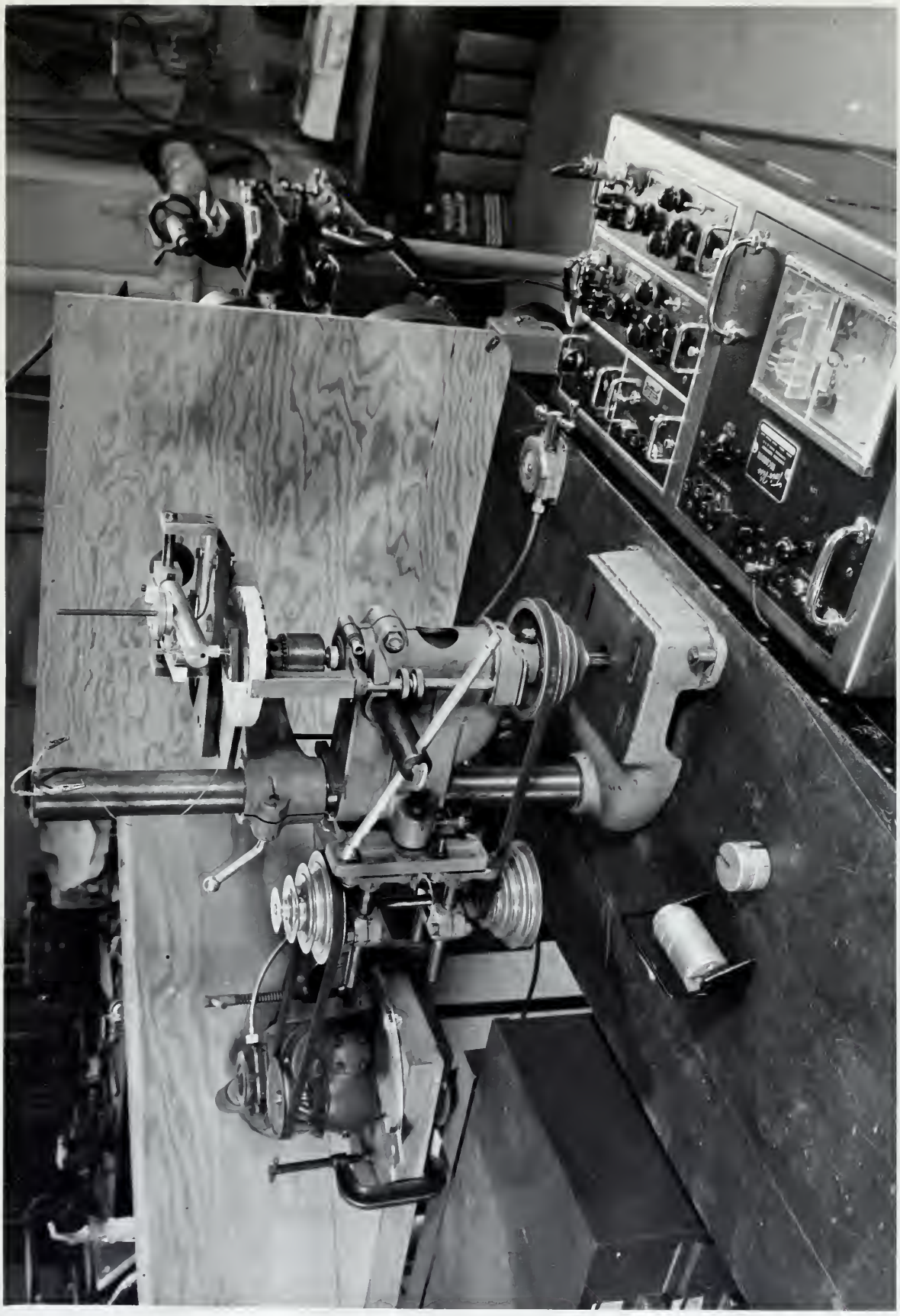


Figure II
Side View of Wear Machine

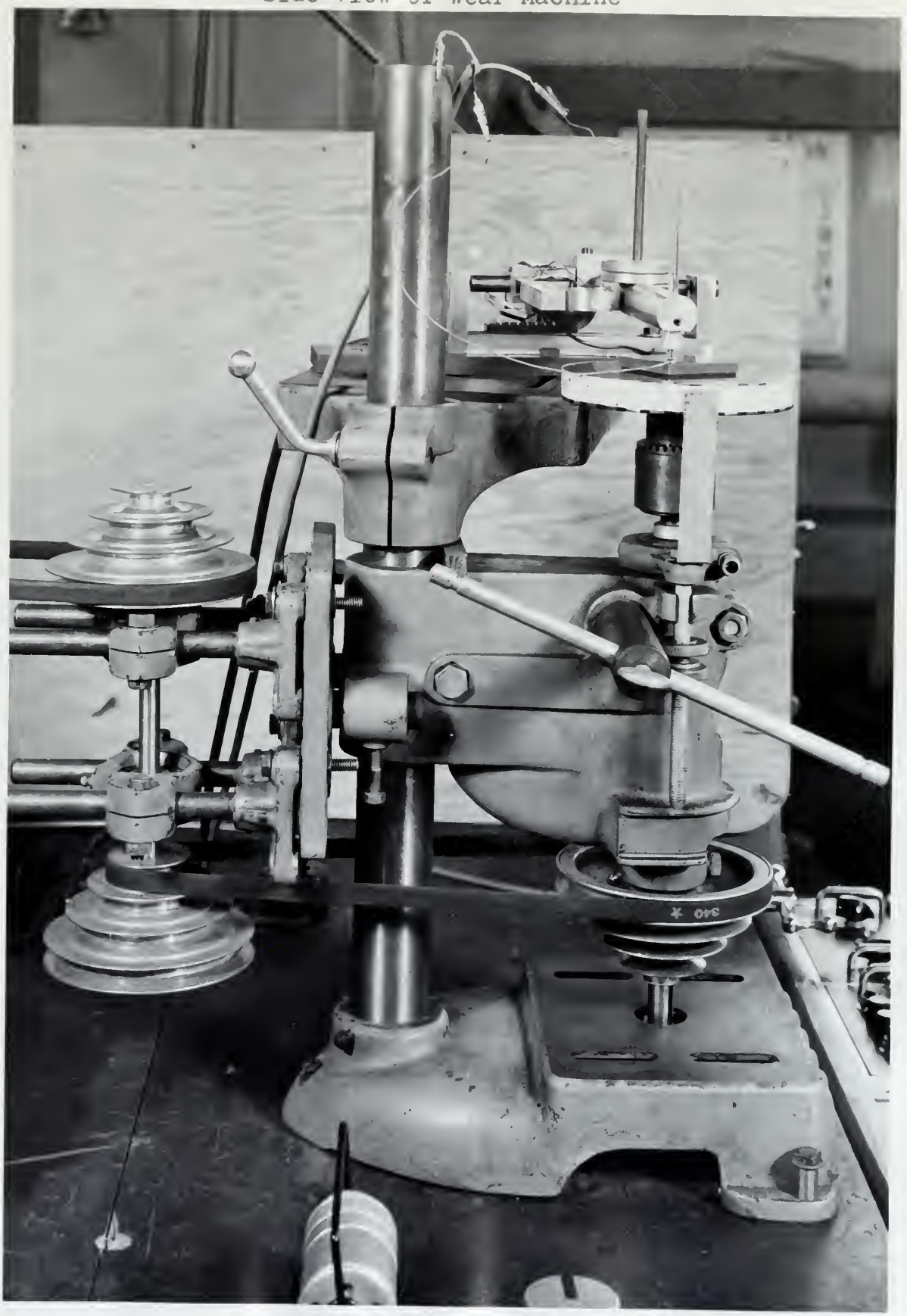


Figure III
Close Up of Mounted Probe

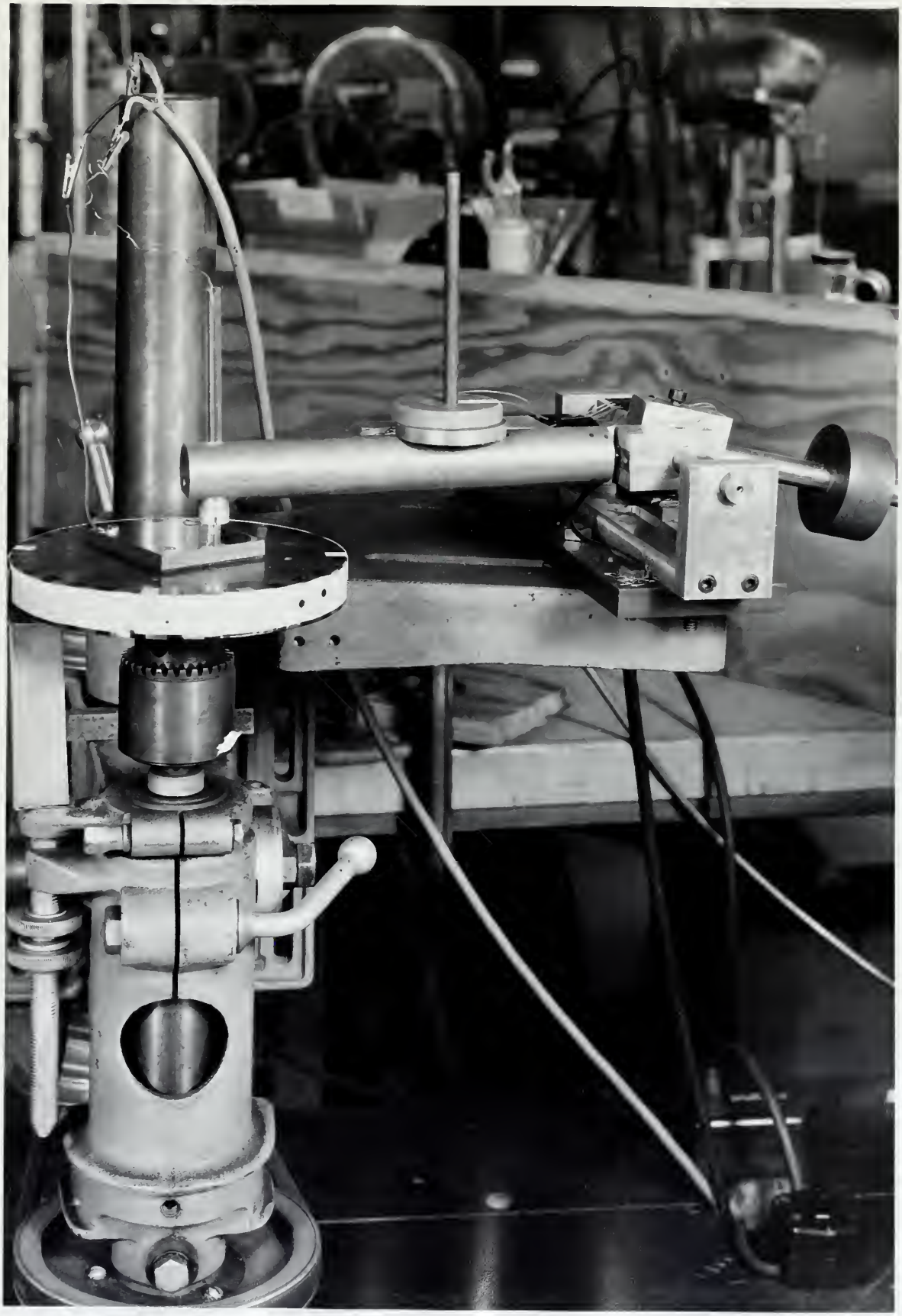
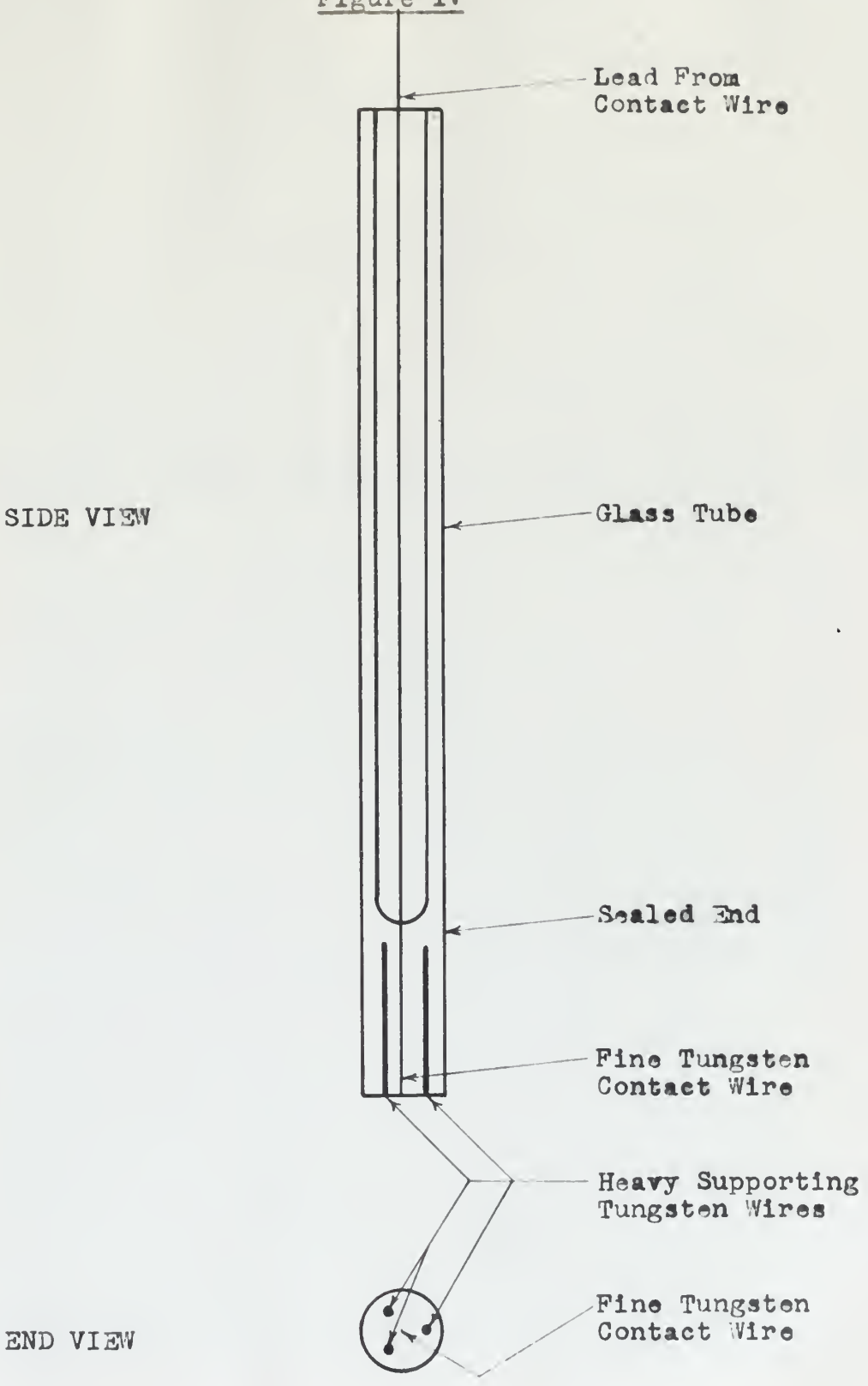


Figure IV



GLASS PROBE (Double the actual size)

APPENDIX B

Representative Tape

Page

Figure 5. Picture, Representative Tape ..... A 7

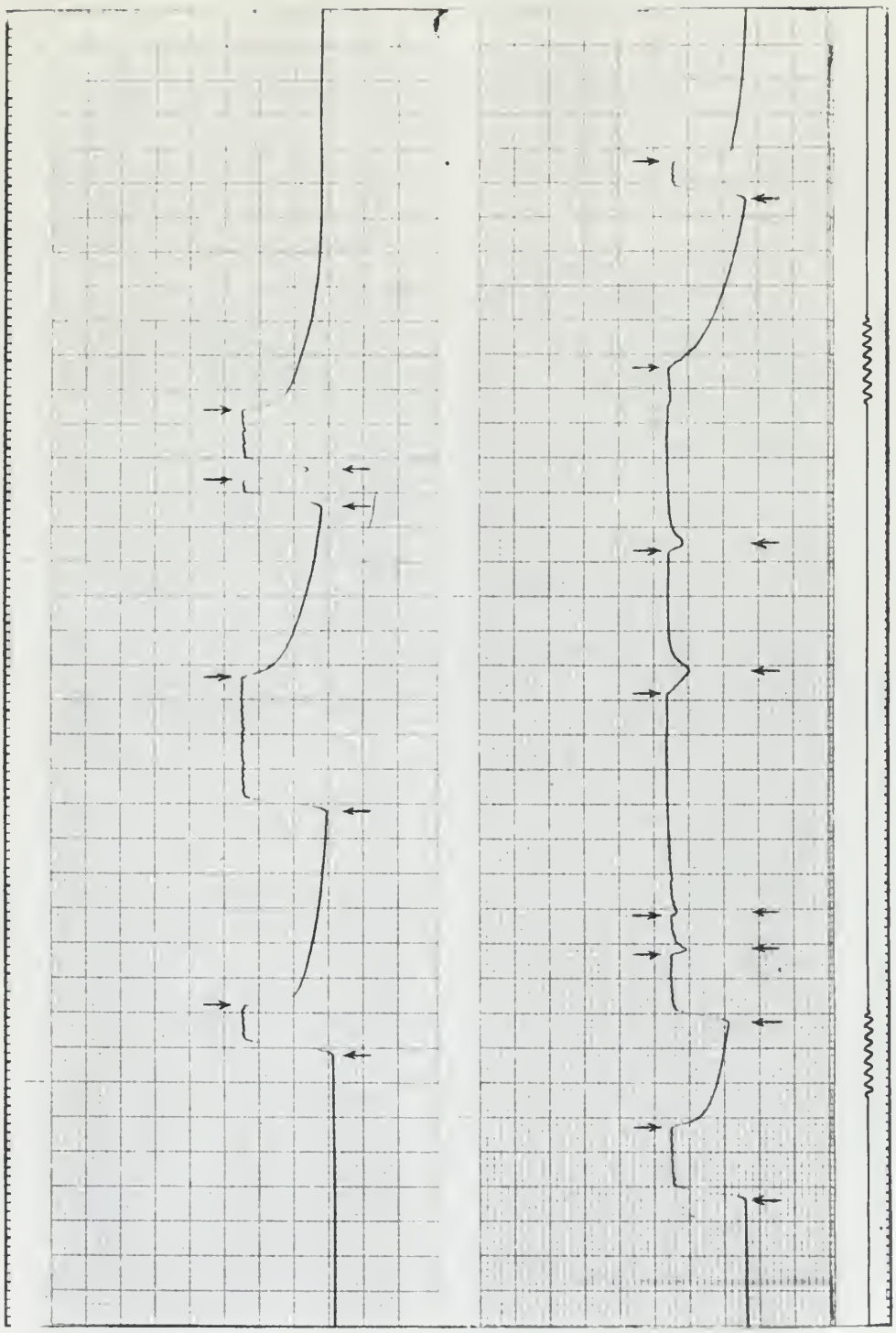
APPENDIX B

Supplementary Data

Page

Figure 5. Figure, Supplementary Data ..... A 7

Figure V



REPRESENTATIVE TAPE TRACES

APPENDIX C

Graphs of Results

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APPENDIX C

Opinion of Insurance

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Figure 6. Plot, average Contract Diameter v.s. Load C-2

Figure 7. Plot, Size Distribution of Contract Areas for All Types C-10

Figure 8. Plot, Size Distribution of Contract Diameter C-11

Areas with Diameters Less Than Three

Figure VI

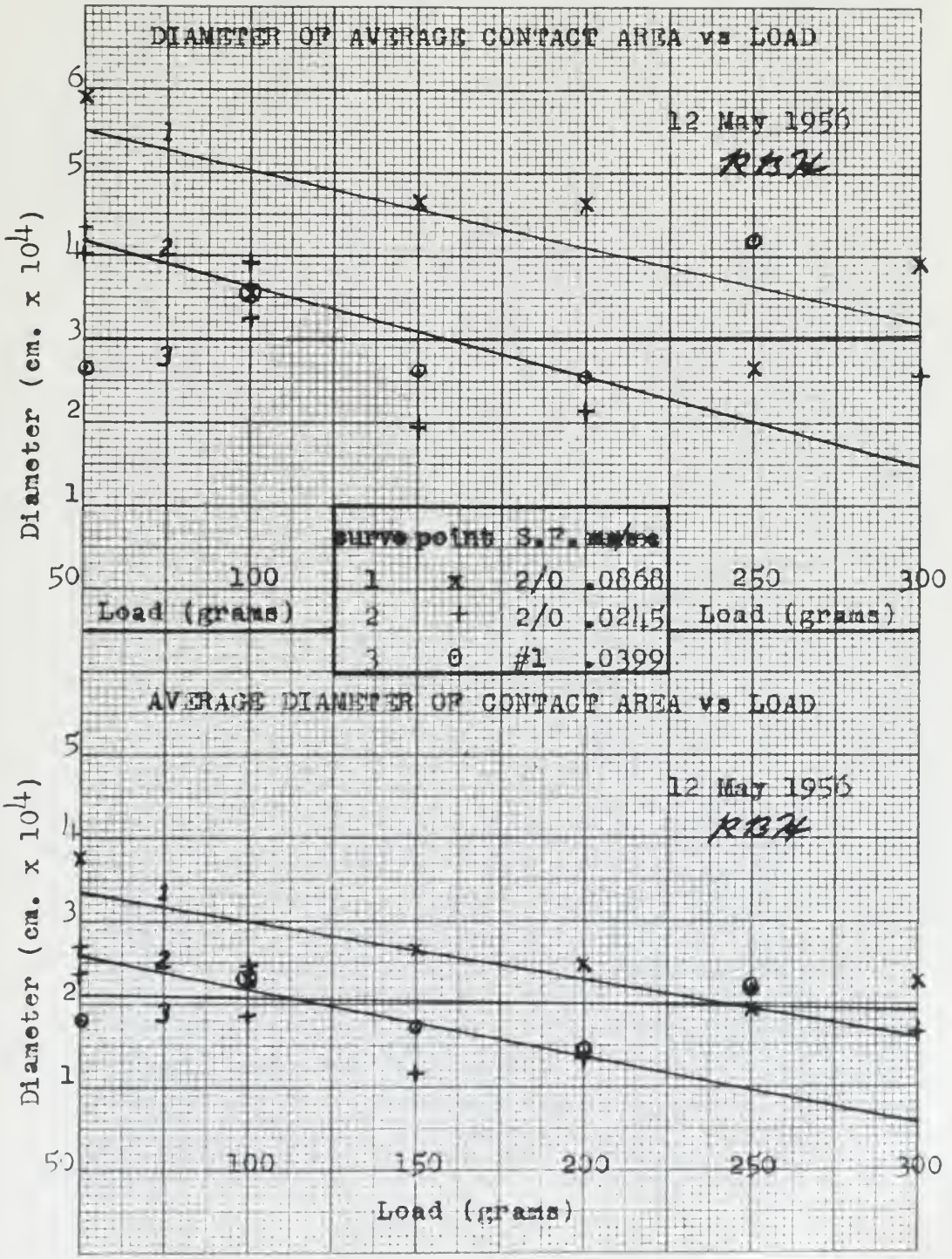

DIAMETER OF AVERAGE CONTACT AREA vs LOAD
12 May 1955
RBK
Diameter (cm. x 10^4)
Load (grams)
curve point S.F. meter
1 x 2/0 .0868
2 + 2/0 .0215
3 0 #1 .0399
AVERAGE DIAMETER OF CONTACT AREA vs LOAD
12 May 1955
RBK
Diameter (cm. x 10^4)
Load (grams)

Figure VII

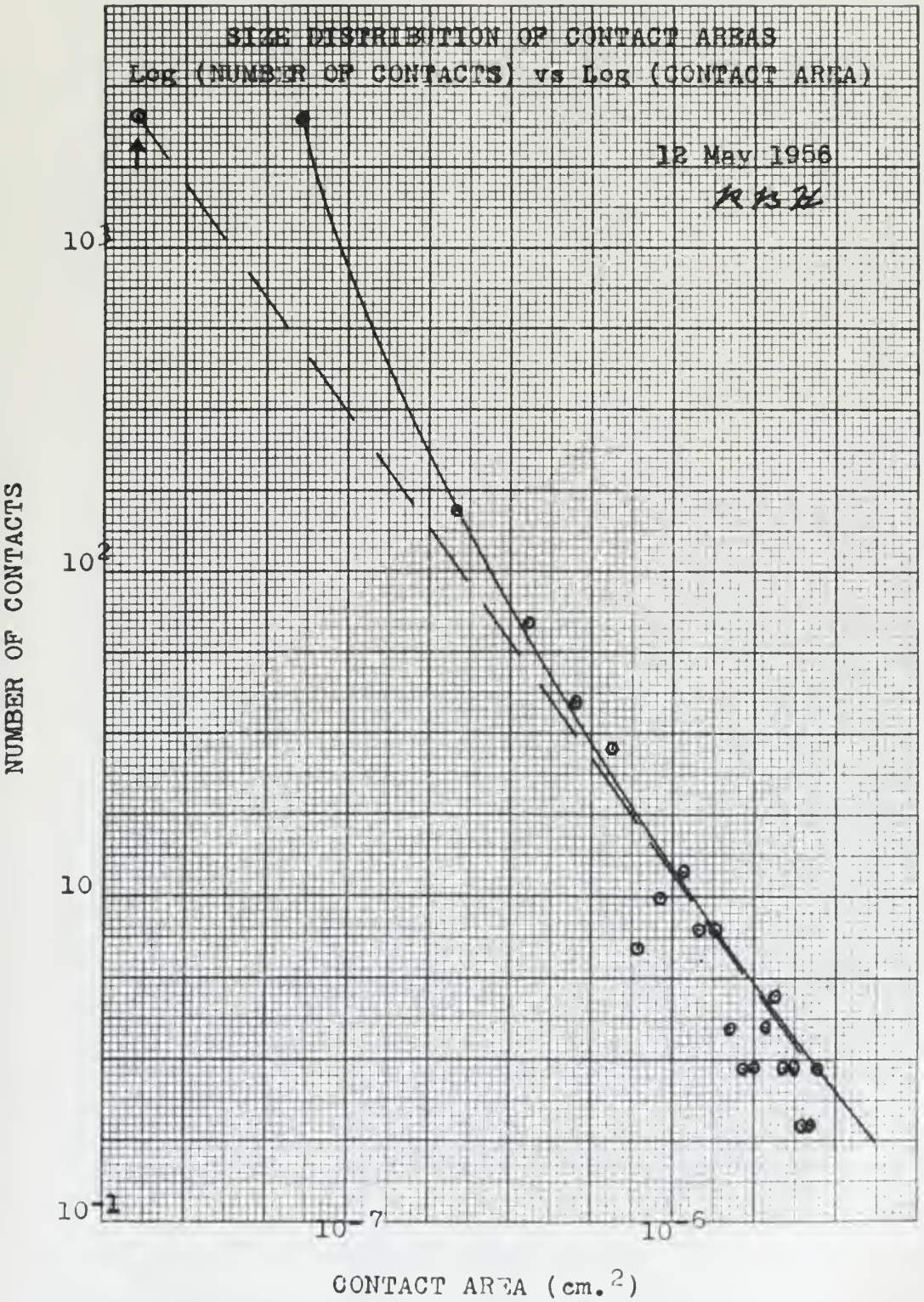
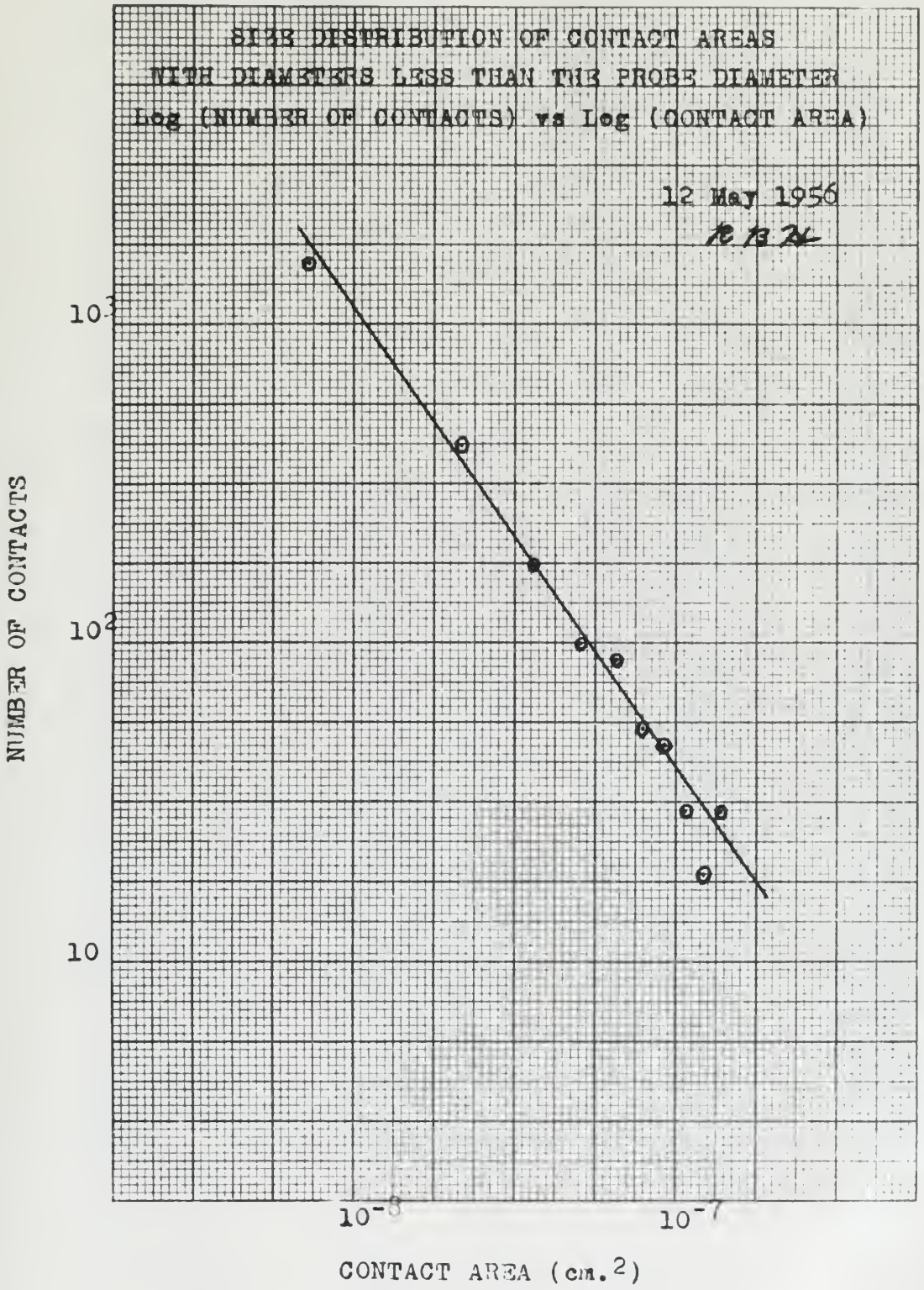

SIZE DISTRIBUTION OF CONTACT AREAS
Log (NUMBER OF CONTACTS) vs Log (CONTACT AREA)
12 May 1956
NUMBER OF CONTACTS
10^3
10^2
10
10^{-1}
10^{-7}
10^{-6}
CONTACT AREA (cm.^{2})

Figure VIII


SIZE DISTRIBUTION OF CONTACT AREAS
WITH DIAMETERS LESS THAN THE PROBE DIAMETER
Log (NUMBER OF CONTACTS) vs Log (CONTACT AREA)
12 May 1956
10^3
10^2
10
NUMBER OF CONTACTS
10^{-8}
10^{-7}
CONTACT AREA (cm.^{2})

APPENDIX D

Identification of Tapes - Tabulated Data

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Table I

IDENTIFICATION OF TAPES AND SUMMARY OF DIAMETER CALCULATIONS

TAPE No.	SURFACE FINISH	LOAD	VELOCITY $X10^2$mm/sec	AVERAGE DIAMETER $X10^4$cm	DIAMETER OF AVERAGE AREA $X10^4$cm
1	2/0	100	2.45	2.37	4.01
2	2/0	100		1.87	4.33
3	2/0	200		2.70	3.24
4	2/0	200		2.46	3.92
5	2/0	300		1.46	1.93
6	2/0	400		1.34	2.13
7	2/0	600		1.67	2.55
8	2/0	100	8.68	3.77	5.90
9	2/0	200		2.30	3.53
10	2/0	300		2.63	4.66
11	2/0	400		2.47	4.62
12	2/0	500		1.93	2.66
13	2/0	600		2.28	3.91
14	1	100	3.99	1.81	2.67
15	1	200		2.33	3.58
16	1	300		1.74	2.61
17	1	400		1.43	2.55
18	1	500		2.21	4.19

Table 1

Identification of Tank 4 and Building Oil Absorber Operations

Conditions

Tank No.	Number and Size	Load	Oil Quantity	Average Weekly Throughput	Diameter of Annular Space
		%	10^3 cm^3/sec	10^6 cm^3	10^2 cm
1	2/0	100	2.45	2.37	4.61
2	2/0	100		1.87	4.33
3	2/0	200		2.70	3.34
4	2/0	200		2.40	3.62
5	2/0	300		1.66	2.73
6	2/0	400		1.20	2.13
7	2/0	600		1.07	2.55
8	2/0	100	2.68	3.11	5.38
9	2/0	200		2.30	3.53
10	2/0	300		2.03	4.06
11	2/0	400		2.47	4.89
12	2/0	500		1.93	3.66
13	2/0	600		2.04	3.91
14	1	100	3.39	1.81	2.47
15	1	200		2.33	3.28
16	1	300		1.74	2.81
17	1	400		1.43	2.35
18	1	500		2.21	4.13

Table II

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 1

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	33.8	20	23.7	39	10.0	58	33.8
2	104.0	21	31.2	40	6.0	59	20.2
3	77.0	22	17.3	41	5.6	60	20.8
4	10.0	23	3.0	42	20.2	61	41.0
5	4.9	24	8.0	43	.7	62	8.0
6	8.8	25	2.0	44	16.7	63	5.8
7	17.2	26	9.2	45	5.1	64	4.0
8	19.0	27	5.0	46	77.0	65	10.5
9	155.7	28	6.7	47	5.7	66	61.5
10	72.6	29	59.0	48	29.0	67	4.0
11	15.3	30	18.6	49	3.0	68	4.0
12	9.9	31	5.3	50	3.0	69	16.2
13	4.3	32	5.2	51	4.6	70	8.5
14	2.9	33	5.0	52	4.7	71	5.2
15	8.0	34	38.1	53	34.2	72	4.1
16	2.6	35	42.1	54	39.1	73	11.7
17	3.0	36	8.1	55	17.9	74	3.3
18	1.0	37	6.5	56	11.4	75	12.0
19	24.2	38	4.8	57	5.2		

Table 11

No.	Distance	No.	Distance	No.	Distance	No.	Distance
1	33.6	20	43.7	39	10.0	58	33.4
2	104.2	21	14.2	40	4.0	59	20.8
3	17.0	22	17.3	41	3.0	60	60.4
4	12.0	23	3.0	42	20.2	61	41.0
5	4.9	24	6.0	43	.7	62	4.0
6	8.4	25	2.0	44	16.7	63	5.4
7	17.3	26	3.6	45	3.1	64	4.0
8	10.0	27	5.0	46	11.0	65	10.5
9	105.1	28	6.7	47	5.7	66	61.3
10	14.6	29	39.0	48	23.0	67	4.0
11	13.3	30	16.6	49	3.0	68	4.0
12	3.3	31	3.3	50	3.0	69	14.2
13	4.3	32	3.6	51	4.4	70	4.5
14	6.0	33	3.0	52	4.7	71	6.2
15	8.0	34	20.1	53	34.4	72	4.1
16	2.4	35	12.1	54	39.1	73	11.7
17	3.0	36	6.1	55	17.9	74	3.3
18	1.0	37	6.3	56	11.4	75	12.0
19	24.4	38	4.8	57	3.2		

Table III

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 2

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	12.3	26	2.0	51	6.0	76	11.5
2	8.5	27	28.3	52	6.9	77	12.8
3	26.6	28	2.8	53	13.1	78	1.9
4	21.7	29	105.6	54	8.8	79	27.2
5	84.4	30	27.7	55	4.8	80	34.6
6	10.5	31	12.0	56	15.0	81	18.7
7	10.0	32	1.7	57	34.6	82	19.3
8	76.1	33	12.5	58	21.0	83	6.7
9	10.5	34	10.7	59	11.6	84	94.5
10	33.3	35	10.8	60	13.0	85	101.8
11	4.8	36	6.7	61	15.3	86	94.4
12	6.7	37	6.9	62	52.0	87	11.2
13	48.8	38	4.7	63	5.2	88	15.1
14	8.0	39	11.6	64	44.3	89	44.5
15	68.5	40	30.5	65	21.0	90	37.0
16	45.4	41	3.0	66	53.0	91	27.9
17	7.9	42	1.7	67	3.3	92	21.7
18	2.7	43	1.4	68	3.8	93	19.5
19	1.8	44	14.4	69	3.1	94	46.1
20	39.8	45	4.0	70	16.0	95	10.0
21	7.8	46	10.9	71	8.3	96	2.1
22	8.7	47	43.8	72	10.6	97	5.7
23	53.0	48	34.0	73	6.0	98	10.1
24	5.2	49	3.0	74	13.3	99	8.8
25	0.1	50	5.4	75	2.5	100	57.7

Table III

TOTAL CONSUMPTION STATISTICS (MW) FOR YEARS No. 2

No.		No.		No.		No.	
1	12.3	26	2.0	51	0.1	76	11.5
2	6.5	27	24.3	52	6.7	77	12.4
3	26.6	28	2.8	53	13.1	78	1.9
4	21.7	29	105.6	54	8.4	79	27.2
5	4.4	30	27.7	55	4.8	80	32.0
6	14.5	31	12.0	56	15.4	81	12.7
7	16.0	32	1.7	57	34.6	82	19.3
8	16.1	33	12.1	58	21.0	83	6.7
9	12.5	34	10.7	59	11.8	84	14.3
10	31.3	35	10.8	60	13.0	85	101.4
11	4.4	36	6.7	61	18.3	86	24.4
12	6.7	37	6.3	62	34.0	87	11.8
13	46.2	38	4.7	63	5.4	88	13.3
14	5.0	39	11.4	64	24.3	89	24.3
15	27.3	40	34.3	65	21.3	90	17.0
16	34.4	41	1.0	66	33.0	91	27.9
17	7.3	42	1.7	67	3.3	92	21.7
18	1.1	43	1.4	68	5.8	93	13.3
19	1.8	44	11.4	69	3.1	94	24.1
20	33.7	45	4.0	70	10.8	95	10.6
21	1.8	46	10.3	71	4.3	96	24.1
22	6.7	47	43.4	72	10.6	97	3.7
23	33.4	48	34.3	73	4.3	98	10.1
24	4.2	49	1.0	74	13.3	99	2.4
25	3.1	50	3.4	75	8.3	100	31.7

Table III

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 2

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	2.6	118	52.6	135	4.0	151	4.1
102	19.1	119	12.1	136	53.2	152	8.9
103	104.6	120	55.1	137	6.4	153	1.2
104	86.3	121	19.3	138	21.5	154	6.7
105	110.5	122	72.9	139	3.0	155	5.6
106	7.7	123	36.5	140	6.4	156	14.3
107	54.1	124	2.4	141	9.0	157	2.0
108	157.3	125	7.1	142	3.4	158	6.0
109	116.0	126	6.3	143	14.1	159	10.0
110	10.1	127	5.4	144	8.7	160	4.1
111	28.0	128	31.9	145	3.7	161	4.2
112	5.2	129	7.8	146	5.0	162	3.4
113	39.2	130	31.9	147	14.4	163	8.2
114	46.0	131	5.2	148	20.3	164	4.2
115	30.0	132	11.1	149	17.6	165	2.0
116	12.4	133	11.4	150	3.4	166	4.2
117	47.9	134	9.0				

Table III

Exact distance (mm) for two No. 2

No.	Distance	No.	Distance	No.	Distance
101	4.0	114	94.6	135	0.0
102	19.1	115	12.3	136	43.3
103	104.0	116	99.1	137	6.4
104	84.	121	15.3	138	83.5
105	110.3	122	78.9	139	3.0
106	7.7	123	36.3	140	6.7
107	95.1	124	2.4	141	3.0
108	131.3	125	7.1	142	3.4
109	110.0	126	6.3	143	14.1
110	12.1	127	3.4	144	4.7
111	84.0	128	32.1	145	3.7
112	5.3	129	1.5	146	5.0
113	38.2	130	31.3	147	14.4
114	96.0	131	3.8	148	26.3
115	30.0	132	11.1	149	17.6
116	12.4	133	11.4	150	3.4
117	41.3	134	8.8		

No.	Distance	No.	Distance	No.	Distance
151	6.1	152	4.3	153	7.4
154	5.0	155	8.8	156	14.3
157	3.0	158	4.0	159	10.0
160	4.1	161	4.2	162	3.4
163	4.3	164	4.2	165	4.3
166	4.2				

Table IV

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 3

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	32.1	16	20.5	31	3.8	46	5.2
2	4.3	17	6.0	32	62.7	47	3.9
3	5.4	18	5.5	33	3.4	48	7.4
4	5.5	19	7.0	34	6.1	49	23.0
5	3.6	20	1.5	35	3.9	50	23.2
6	15.1	21	5.2	36	3.9	51	11.7
7	7.3	22	17.1	37	7.8	52	71.2
8	74.9	23	5.6	38	4.3	53	23.6
9	12.0	24	11.5	39	12.4	54	6.2
10	11.1	25	4.0	40	10.9	55	10.4
11	13.2	26	3.9	41	4.8	56	6.8
12	10.1	27	4.8	42	15.3	57	3.2
13	5.8	28	2.9	43	24.0	58	9.6
14	5.9	29	5.9	44	23.5	59	47.1
15	3.6	30	36.6	45	115.1		

Table 47

Table V

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 4

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	54.3	26	9.2	51	47.2	76	7.9
2	110.2	27	5.2	52	23.5	77	7.6
3	3.5	28	14.3	53	51.0	78	17.8
4	23.0	29	11.6	54	66.1	79	7.5
5	3.1	30	7.4	55	34.7	80	17.5
6	205.0	31	5.9	56	8.8	81	7.7
7	32.0	32	22.3	57	8.2	82	11.6
8	2.0	33	14.1	58	16.3	83	60.1
9	3.0	34	93.5	59	13.1	84	39.6
10	11.0	35	2.4	60	11.0	85	13.4
11	7.0	36	136.0	61	7.9	86	6.1
12	24.3	37	22.9	62	12.3	87	41.4
13	48.4	38	25.3	63	24.6	88	2.0
14	96.5	39	16.0	64	7.3	89	8.7
15	68.3	40	11.9	65	24.0	90	8.1
16	31.7	41	58.7	66	4.3	91	2.1
17	7.4	42	49.3	67	7.0	92	16.2
18	11.3	43	9.0	68	16.2	93	25.7
19	7.0	44	12.5	69	3.9	94	12.6
20	3.8	45	34.6	70	18.0	95	4.1
21	2.5	46	17.4	71	11.8	96	30.0
22	2.0	47	9.8	72	4.0	97	11.0
23	7.6	48	30.3	73	5.8	98	13.0
24	8.3	49	6.8	74	10.2	99	1[illegible]
25	47.0	50	15.3	75	6.2	100	5.5

Table V

No.		No.		No.		No.	
1	24.3	26	9.2	51	47.2	76	1.9
2	120.2	27	5.1	52	23.5	77	1.6
3	3.5	28	14.3	53	52.0	78	17.8
4	63.4	29	11.6	54	66.1	79	7.5
5	3.1	30	1.4	55	34.1	80	17.5
6	205.0	31	5.3	56	8.6	81	7.7
7	32.0	32	26.3	57	8.2	82	11.6
8	2.0	33	14.1	58	16.3	83	60.1
9	3.0	34	23.5	59	13.1	84	39.6
10	11.0	35	2.6	60	11.0	85	13.4
11	1.0	36	139.0	61	1.3	86	4.1
12	24.3	37	23.9	62	12.3	87	41.4
13	48.4	38	24.3	63	24.6	88	2.0
14	16.3	39	11.0	64	7.3	89	6.7
15	68.3	40	11.3	65	24.0	90	8.1
16	31.7	41	58.7	66	4.3	91	2.3
17	1.4	42	49.3	67	1.0	92	16.2
18	11.3	43	9.0	68	16.4	93	25.7
19	1.0	44	12.8	69	3.3	94	12.6
20	3.8	45	34.0	70	13.0	95	4.1
21	8.3	46	17.4	71	11.8	96	34.3
22	2.0	47	4.2	72	4.0	97	11.1
23	1.6	48	30.3	73	5.6	98	13.1
24	8.3	49	6.4	74	10.2	99	41.3
25	47.0	50	19.3	75	6.3	100	4.3

Table V

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 4

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	2.6	109	5.5	117	12.3	125	6.5
102	12.6	110	2.3	118	3.5	126	36.0
103	28.9	111	10.7	119	9.0	127	9.0
104	6.1	112	2.2	120	13.9	128	4.8
105	5.0	113	6.5	121	3.2	129	3.2
106	7.0	114	3.1	122	55.9	130	7.8
107	8.9	115	11.0	123	25.4	131	9.6
108	4.6	116	6.0	124	4.0		

Table V

Table VI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 5

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	3.6	26	10.5	51	4.1	76	8.9
2	5.3	27	2.5	52	7.1	77	8.4
3	7.7	28	4.5	53	6.0	78	9.0
4	18.8	29	11.1	54	.8	79	10.7
5	4.4	30	7.2	55	3.9	80	4.3
6	3.1	31	15.5	56	3.0	81	14.9
7	4.7	32	5.3	57	20.0	82	7.9
8	4.7	33	15.5	58	25.1	83	25.8
9	15.2	34	6.0	59	13.4	84	4.6
10	25.5	35	4.5	60	4.0	85	11.0
11	3.5	36	3.8	61	7.3	86	5.4
12	3.6	37	8.1	62	22.6	87	3.0
13	4.2	38	7.1	63	6.0	88	4.3
14	5.3	39	5.8	64	20.3	89	3.4
15	3.0	40	2.3	65	8.5	90	10.0
16	19.1	41	11.0	66	12.7	91	3.9
17	7.1	42	2.0	67	5.2	92	6.3
18	4.0	43	4.1	68	7.0	93	5.0
19	3.5	44	5.8	69	14.2	94	5.1
20	10.7	45	2.0	70	5.0	95	9.0
21	19.1	46	4.0	71	3.8	96	10.2
22	5.0	47	3.0	72	7.9	97	3.4
23	2.2	48	2.0	73	3.1	98	11.7
24	1.0	49	2.0	74	3.9	99	12.2
25	5.6	50	3.5	75	15.5	100	5.2

TABLE VI

[illegible]

Table VI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 5

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	2.3	126	7.0	151	6.4	176	5.8
102	15.0	127	2.4	152	20.6	177	11.4
103	5.1	128	6.0	153	4.9	178	13.1
104	24.3	129	8.7	154	22.2	179	3.8
105	5.2	130	3.4	155	7.0	180	5.9
106	4.1	131	2.0	156	7.6	181	5.8
107	2.2	132	6.2	157	9.2	182	3.1
108	23.5	133	8.3	158	11.4	183	3.3
109	5.5	134	5.5	159	7.2	184	2.3
110	6.7	135	5.6	160	2.5	185	5.0
111	35.0	136	7.0	161	5.3	186	9.5
112	14.5	137	15.0	162	3.7	187	8.2
113	5.0	138	4.6	163	7.5	188	17.3
114	1.9	139	4.0	164	10.5	189	10.9
115	3.2	140	14.0	165	9.0	190	7.1
116	2.9	141	8.4	166	6.5	191	78.7
117	2.1	142	3.8	167	5.5	192	11.9
118	1.0	143	5.7	168	1.2	193	29.5
119	7.0	144	1.0	169	39.6	194	14.8
120	18.1	145	22.3	170	10.2	195	10.5
121	21.2	146	7.3	171	23.9	196	3.9
122	12.5	147	7.0	172	2.4	197	5.3
123	15.4	148	10.5	173	8.0	198	.8
124	5.8	149	8.5	174	3.2	199	12.2
125	4.0	150	6.5	175	1.0	200	20.8

TABLE VI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 5

Table VI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 5

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	14.0	216	19.1	231	10.0	246	9.6
202	22.2	217	5.1	232	23.9	247	10.7
203	2.3	218	4.4	233	3.9	248	13.7
204	15.8	219	10.5	234	12.0	249	6.6
205	5.8	220	24.3	235	15.9	250	144.7
206	5.4	221	4.3	236	5.1	251	10.0
207	2.8	222	5.6	237	6.0	252	10.9
208	2.2	223	3.1	238	2.7	253	9.7
209	3.6	224	27.2	239	4.0	254	7.2
210	9.0	225	8.3	240	26.0	255	8.9
211	4.0	226	9.3	241	40.3	256	8.7
212	5.3	227	20.6	242	8.7	257	2.0
213	3.8	228	2.0	243	10.3	258	4.6
214	5.6	229	2.5	244	3.3	259	4.6
215	4.0	230	4.0	245	9.6	260	34.0

TABLE VI

TABLE CONTAINS DISTANCES (mm) FOR TABLE No. 5

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	14.6	236	19.1	271	34.0	296	3.6
202	46.6	217	5.1	272	63.9	297	19.7
203	2.3	238	4.4	273	3.3	298	13.7
204	13.6	239	16.3	274	12.0	299	0.0
205	3.6	240	24.3	275	13.3	300	144.7
206	3.4	241	4.3	276	5.1	301	16.4
207	2.6	242	3.0	277	6.4	302	16.3
208	2.4	243	3.1	278	8.7	303	9.7
209	3.3	244	27.2	279	4.0	304	7.3
210	3.0	245	8.3	280	28.0	305	6.3
211	4.0	246	4.3	281	40.3	306	6.7
212	3.3	247	20.6	282	8.1	307	2.0
213	3.6	248	8.0	283	10.3	308	4.4
214	3.4	249	2.8	284	3.3	309	4.3
215	4.0	250	4.0	285	3.0	310	34.0

Table VII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 6

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	118.5	26	8.5	51	5.0	76	12.2
2	14.9	27	1.0	52	17.7	77	14.8
3	7.0	28	5.1	53	5.3	78	20.4
4	15.7	29	5.9	54	5.0	79	38.6
5	22.2	30	3.6	55	11.9	80	2.6
6	3.6	31	4.1	56	9.7	81	10.8
7	23.5	32	5.0	57	3.8	82	15.0
8	15.1	33	5.6	58	10.0	83	5.7
9	10.0	34	34.0	59	10.1	84	39.8
10	25.6	35	12.7	60	8.3	85	5.9
11	28.8	36	9.0	61	5.6	86	2.6
12	21.0	37	14.0	62	12.0	87	1.8
13	24.0	38	12.1	63	2.0	88	1.5
14	8.5	39	7.1	64	3.1	89	7.0
15	2.2	40	31.1	65	2.1	90	2.8
16	3.7	41	5.4	66	3.8	91	2.4
17	7.2	42	10.6	67	7.1	92	12.0
18	5.6	43	8.1	68	9.5	93	14.7
19	5.5	44	3.7	69	3.9	94	3.6
20	8.0	45	3.0	70	3.7	95	8.6
21	7.6	46	49.1	71	5.0	96	1.7
22	7.2	47	3.8	72	23.6	97	7.2
23	5.6	48	5.5	73	10.1	98	2.7
24	6.0	49	3.7	74	22.3	99	10.2
25	4.0	50	3.6	75	18.6	100	3.0

TABLE XII

No.		No.		No.		No.	
1		26		51		76	
2		27		52		77	
3		28		53		78	
4		29		54		79	
5		30		55		80	
6		31		56		81	
7		32		57		82	
8		33		58		83	
9		34		59		84	
10		35		60		85	
11		36		61		86	
12		37		62		87	
13		38		63		88	
14		39		64		89	
15		40		65		90	
16		41		66		91	
17		42		67		92	
18		43		68		93	
19		44		69		94	
20		45		70		95	
21		46		71		96	
22		47		72		97	
23		48		73		98	
24		49		74		99	
25		50		75		100	

Table VII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 6

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	49.1	120	45.8	139	5.9	158	10.8
102	10.5	121	17.2	140	2.9	159	5.0
103	15.1	122	4.6	141	7.0	160	9.8
104	26.6	123	10.0	142	4.5	161	3.2
105	4.6	124	1.1	143	4.0	162	4.8
106	13.0	125	9.8	144	16.2	163	3.5
107	4.1	126	12.0	145	12.5	164	1.2
108	3.0	127	5.5	146	12.0	165	2.2
109	2.0	128	11.2	147	4.0	166	3.2
110	6.9	129	2.6	148	5.2	167	2.4
111	4.0	130	1.0	149	11.5	168	3.3
112	8.1	131	6.7	150	6.0	169	11.8
113	1.8	132	5.3	151	5.3	170	7.8
114	24.1	133	4.6	152	2.8	171	4.7
115	30.5	134	5.1	153	3.9	172	36.0
116	4.2	135	32.3	154	23.0	173	41.0
117	4.1	136	5.9	155	27.0	174	7.5
118	4.1	137	9.0	156	12.8	175	2.5
119	17.3	138	12.1	157	20.0		

Table 121

TRAIN CONTACT DISTANCES (mm) FOR TAPE No. 6

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	4.3	120	4.6	139	3.9	158	10.8
102	14.4	121	17.6	140	8.9	159	5.0
103	12.1	122	6.0	141	7.0	160	6.4
104	26.6	123	10.0	142	4.9	161	3.8
105	4.6	124	1.3	143	4.0	162	4.4
106	13.0	125	3.8	144	12.4	163	3.3
107	4.1	126	12.0	145	12.9	164	1.8
108	3.0	127	5.5	146	12.0	165	8.8
109	2.0	128	11.2	147	4.0	166	3.2
110	8.9	129	2.6	148	9.8	167	4.4
111	4.0	130	1.0	149	11.5	168	3.3
112	8.3	131	6.7	150	6.0	169	12.0
113	1.6	132	5.5	151	5.7	170	7.6
114	24.1	133	4.0	152	2.4	171	0.1
115	20.5	134	5.1	153	3.9	172	36.0
116	4.8	135	36.3	154	23.0	173	62.0
117	4.3	136	5.5	155	27.0	174	1.5
118	4.1	137	8.0	156	12.8	175	2.0
119	17.3	138	14.1	157	20.0		

Table VIII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 7

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	37.0	26	8.3	51	1.7	76	6.6
2	4.0	27	10.6	52	39.6	77	39.7
3	4.0	28	6.0	53	11.4	78	16.0
4	10.8	29	3.7	54	17.0	79	12.1
5	4.1	30	46.0	55	45.5	80	8.7
6	12.0	31	5.8	56	11.2	81	3.3
7	5.8	32	10.0	57	12.2	82	9.2
8	10.0	33	6.0	58	1.7	83	4.0
9	17.1	34	22.1	59	6.8	84	3.5
10	48.8	35	3.7	60	11.6	85	73.4
11	26.9	36	8.4	61	6.7	86	8.7
12	6.0	37	1.5	62	4.0	87	5.7
13	5.2	38	50.8	63	6.2	88	5.1
14	20.7	39	5.2	64	19.3	89	24.5
15	11.2	40	3.2	65	5.0	90	61.3
16	50.0	41	1.7	66	8.8	91	50.9
17	12.6	42	10.8	67	8.0	92	15.2
18	11.9	43	3.3	68	4.0	93	4.8
19	4.6	44	4.1	69	7.8	94	11.7
20	15.7	45	1.2	70	1.6	95	12.5
21	66.0	46	29.7	71	4.2	96	9.8
22	6.2	47	22.0	72	3.4	97	2.0
23	4.1	48	2.9	73	8.7	98	21.4
24	1.3	49	1.6	74	2.0	99	15.0
25	4.8	50	2.0	75	11.2	100	23.3

Table VIII

No.		No.		No.		No.	
1	31.8	26	6.3	51	1.1	76	6.6
2	4.0	27	10.0	52	39.4	77	29.7
3	6.0	28	8.0	53	11.4	78	14.8
4	10.8	29	3.7	54	17.4	79	12.2
5	8.1	30	46.8	55	45.5	80	6.1
6	12.0	31	5.4	56	11.4	81	3.3
7	5.8	32	10.0	57	18.5	82	3.4
8	10.0	33	6.4	58	1.1	83	4.0
9	17.1	34	22.1	59	8.4	84	3.3
10	46.2	35	3.1	60	11.8	85	17.4
11	20.9	36	4.4	61	6.7	86	8.1
12	1.0	37	15.9	62	4.4	87	3.1
13	5.2	38	20.8	63	6.2	88	3.2
14	20.7	39	6.2	64	19.5	89	24.2
15	11.2	40	3.8	65	3.8	90	11.3
16	20.0	41	1.7	66	6.8	91	20.3
17	14.6	42	18.8	67	8.4	92	18.8
18	11.3	43	3.1	68	4.6	93	4.4
19	4.6	44	6.2	69	1.8	94	14.7
20	18.7	45	1.8	70	1.1	95	12.3
21	30.0	46	23.1	71	4.6	96	3.8
22	6.2	47	21.6	72	3.4	97	1.4
23	4.1	48	8.8	73	8.7	98	21.4
24	1.3	49	1.8	74	5.0	99	13.4
25	8.8	50	5.4	75	11.8	100	13.3

Table VIII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 7

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	41.7	106	4.1	111	11.0	116	5.8
102	2.0	107	10.4	112	2.0	117	4.1
103	8.6	108	5.6	113	61.8	118	19.0
104	7.0	109	29.7	114	4.6	119	4.9
105	4.9	110	8.3	115	13.6	120	8.0

Table VIII

Table IX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 8

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	3.7	26	1.0	51	4.2	76	4.2
2	3.0	27	.5	52	4.7	77	1.8
3	1.7	28	1.7	53	1.1	78	1.1
4	6.2	29	6.4	54	2.0	79	5.0
5	28.0	30	2.5	55	23.0	80	2.0
6	10.0	31	4.1	56	12.9	81	4.2
7	1.0	32	1.8	57	11.0	82	3.0
8	1.2	33	20.0	58	10.0	83	5.8
9	2.8	34	22.0	59	10.3	84	2.7
10	4.7	35	1.0	60	5.0	85	11.0
11	21.9	36	41.0	61	3.9	86	37.7
12	2.3	37	2.6	62	.5	87	55.2
13	3.1	38	37.0	63	6.1	88	2.8
14	5.1	39	7.0	64	3.8	89	46.9
15	4.0	40	24.5	65	9.0	90	17.0
16	1.8	41	2.5	66	13.8	91	38.3
17	3.9	42	27.5	67	19.9	92	81.4
18	7.2	43	2.0	68	30.0	93	2.3
19	12.2	44	6.8	69	25.0	94	14.9
20	2.0	45	2.8	70	2.8	95	3.0
21	4.6	46	.8	71	72.2	96	3.0
22	13.1	47	15.7	72	7.0	97	2.7
23	2.3	48	4.8	73	6.0	98	60.0
24	.8	49	1.3	74	6.4	99	34.3
25	1.2	50	1.1	75	5.0	100	21.8

Table 15

No.							
1	3.7	30	1.0	52	4.3	74	4.3
2	3.8	27	.5	52	4.7	77	1.8
3	1.7	28	1.7	53	1.1	78	1.1
4	6.2	29	6.8	54	3.0	79	3.0
5	24.0	30	2.5	55	23.0	80	2.0
6	10.4	31	4.1	56	12.5	81	4.3
7	1.0	32	1.8	57	11.0	82	3.0
8	1.5	33	20.0	58	10.1	83	5.1
9	2.8	34	22.0	59	10.3	84	8.7
10	4.7	35	1.0	60	5.1	85	11.0
11	21.5	36	41.0	61	3.3	86	37.7
12	2.3	37	2.6	62	.1	87	59.2
13	3.1	38	37.0	63	0.1	88	2.1
14	3.1	39	1.1	64	1.0	89	40.1
15	4.0	40	44.1	65	3.0	90	17.0
16	1.8	41	1.5	66	13.0	91	10.3
17	3.9	42	21.1	67	13.3	92	21.4
18	7.2	43	2.0	68	30.0	93	6.3
19	12.1	44	6.1	69	29.0	94	14.3
20	2.0	45	3.0	70	8.3	95	3.0
21	4.0	46	.1	71	12.1	96	1.0
22	13.1	47	16.1	72	1.1	97	1.1
23	3.1	48	4.1	73	6.0	98	40.0
24	.1	49	1.1	74	6.0	99	34.3
25	1.2	50	1.1	75	3.0	100	21.3

Table IX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 8

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	20.1	126	8.0	151	7.1	176	16.0
102	6.6	127	14.0	152	10.5	177	.8
103	3.8	128	4.2	153	15.8	178	31.5
104	4.0	129	1.9	154	15.3	179	15.1
105	12.2	130	5.6	155	18.5	180	2.3
106	1.8	131	12.7	156	8.0	181	14.7
107	16.0	132	.8	157	3.5	182	8.0
108	13.2	133	5.2	158	2.1	183	17.5
109	12.0	134	1.1	159	1.8	184	3.0
110	4.5	135	1.6	160	29.4	185	3.7
111	6.0	136	5.9	161	2.4	186	18.8
112	2.8	137	5.8	162	2.6	187	9.0
113	1.5	138	13.2	163	42.1	188	2.3
114	13.0	139	6.0	164	16.9	189	1.0
115	16.6	140	5.9	165	2.3	190	5.0
116	5.0	141	39.0	166	22.8	191	.5
117	15.8	142	8.0	167	2.7	192	41.5
118	2.5	143	7.0	168	5.5	193	25.5
119	5.5	144	1.3	169	2.5	194	7.2
120	39.2	145	1.1	170	2.0	195	13.6
121	15.0	146	26.3	171	3.5	196	6.5
122	5.9	147	1.1	172	4.0	197	2.8
123	20.5	148	.9	173	1.9	198	15.8
124	1.7	149	25.8	174	3.3	199	11.0
125	5.6	150	5.7	175	1.0	200	7.2

Table 12

No.		No.		No.		No.	
101	20.1	120	8.2	139	7.1	178	15.2
102	8.6	117	14.0	138	16.1	177	4.
103	5.8	116	4.6	137	13.8	176	31.5
104	4.2	115	7.1	136	15.1	175	13.1
105	12.5	114	8.8	135	12.1	174	8.3
106	1.8	113	16.7	134	8.-	173	14.7
107	18.2	112	.8	133	3.3	172	8.2
108	13.4	111	5.2	132	2.1	171	17.5
109	12.2	110	1.1	131	1.8	170	3.2
110	4.5	109	3.6	130	18.4	169	7.7
111	6.2	108	5.9	129	5.4	168	13.8
112	2.8	107	5.8	128	2.2	167	3.2
113	1.5	106	13.2	127	18.3	166	6.3
114	13.2	105	4.2	126	15.3	165	8.2
115	16.4	104	9.9	125	5.3	164	4.2
116	5.2	103	13.2	124	22.8	163	19.3
117	19.4	102	8.2	123	8.7	162	14.2
118	1.2	101	7.2	122	9.5	161	25.4
119	4.-	100	5.3	121	6.3	160	7.2
120	20.4	99	4.3	120	4.2	159	15.8
121	1.7	98	25.4	119	1.3	158	11.2
122	5.4	97	4.2	118	15.2	157	7.2

Table IX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 8

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	7.0	226	43.0	251	1.2	276	11.7
202	8.1	227	5.1	252	.7	277	4.0
203	47.8	228	15.3	253	1.1	278	18.7
204	1.3	229	2.2	254	17.5	279	2.0
205	2.2	230	1.1	255	1.9	280	11.7
206	1.0	231	5.1	256	.7	281	2.4
207	7.2	232	1.5	257	44.2	282	3.5
208	2.9	233	1.0	258	14.9	283	1.3
209	7.5	234	28.8	259	7.1	284	1.3
210	5.2	235	2.1	260	3.2	285	1.5
211	5.8	236	6.3	261	.8	286	1.0
212	1.7	237	1.3	262	5.0	287	2.4
213	3.5	238	2.2	263	5.6	288	1.5
214	10.8	239	2.1	264	4.8	289	1.1
215	14.2	240	3.3	265	6.0	290	11.6
216	1.0	241	8.5	266	10.1	291	1.7
217	6.9	242	1.2	267	1.5	292	6.2
218	17.5	243	32.7	268	3.7	293	3.0
219	1.0	244	3.7	269	1.3	294	1.4
220	1.8	245	3.0	270	2.0	295	5.0
221	2.0	246	.6	271	8.0	296	4.0
222	1.3	247	1.5	272	5.6	297	3.0
223	1.0	248	3.0	273	10.0	298	2.0
224	1.5	249	2.9	274	3.1	299	2.3
225	24.1	250	1.5	275	6.0	300	2.2

TABLE A-12

TEST DURATION DISTANCES (mm) FOR TAPE NO. 4

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	7.0	256	49.0	251	1.2	306	12.7
202	8.1	257	3.1	252	.7	277	4.0
203	47.6	258	15.3	253	1.1	278	16.7
204	1.3	259	4.8	254	17.3	279	8.0
205	4.3	230	1.1	255	1.9	280	12.7
206	1.0	231	3.1	256	.7	281	2.4
207	7.2	232	1.3	257	44.2	282	3.1
208	8.9	233	1.8	258	14.9	283	1.3
209	1.9	234	26.8	259	7.1	284	1.3
210	3.8	235	4.1	260	3.2	285	1.3
211	8.8	236	4.3	261	.8	286	1.0
212	1.7	237	1.3	262	5.0	287	8.4
213	3.9	238	2.8	263	3.0	288	1.3
214	10.8	239	2.1	264	4.0	289	1.1
215	14.3	240	3.3	265	8.0	290	12.0
216	1.0	241	8.3	266	10.1	291	1.4
217	5.3	242	1.8	267	1.9	292	8.2
218	17.5	243	32.7	268	3.7	293	3.4
219	3.0	244	3.7	269	1.1	294	12.4
220	1.4	245	3.0	270	2.0	295	3.0
221	5.8	246	.8	271	.4	296	4.0
222	1.3	247	1.3	272	1.4	297	3.0
223	3.0	248	9.0	273	10.0	298	6.1
224	1.4	249	2.3	274	3.1	299	2.3
225	24.1	250	1.4	275	4.8	300	8.2

Table IX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 6

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
301	1.0	315	5.3	328	31.5	341	1.3
302	6.9	316	1.6	329	3.1	342	6.4
303	4.7	317	11.7	330	5.1	343	7.9
304	26.5	318	2.6	331	1.0	344	4.7
305	2.1	319	5.0	332	15.1	345	2.7
306	2.0	320	1.1	333	.8	346	2.0
307	1.0	321	11.9	334	3.1	347	27.8
308	2.4	322	.7	335	1.5	348	6.2
309	15.3	323	15.6	336	3.0	349	5.0
310	1.2	324	7.5	337	2.5	350	8.2
311	2.4	325	1.6	338	3.9	351	3.7
312	1.7	326	1.5	339	2.6	352	2.7
313	5.0	327	6.7	340	6.5	353	1.5
314	4.0						

Table IX

Table X

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 9

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	12.4	26	2.5	51	1.1	76	7.1
2	4.0	27	4.6	52	14.0	77	6.8
3	6.9	28	2.3	53	14.9	78	11.2
4	1.2	29	1.9	54	1.0	79	3.1
5	2.5	30	22.9	55	3.9	80	2.1
6	5.5	31	7.4	56	1.1	81	7.3
7	7.3	32	3.5	57	1.2	82	4.2
8	2.3	33	2.4	58	4.0	83	1.4
9	1.2	34	11.6	59	9.4	84	3.9
10	.7	35	5.0	60	1.1	85	.5
11	4.5	36	1.9	61	2.8	86	24.5
12	10.8	37	5.6	62	4.0	87	2.9
13	3.2	38	9.7	63	3.2	88	28.0
14	2.3	39	20.0	64	7.4	89	1.6
15	6.2	40	2.7	65	2.0	90	3.1
16	10.0	41	1.5	66	6.5	91	2.7
17	4.9	42	1.7	67	3.7	92	3.1
18	3.1	43	1.8	68	1.7	93	9.0
19	3.3	44	1.0	69	.5	94	2.0
20	5.6	45	.9	70	1.9	95	3.1
21	3.9	46	9.9	71	9.4	96	18.2
22	3.8	47	10.2	72	4.8	97	2.1
23	4.0	48	6.7	73	4.1	98	1.6
24	1.2	49	14.0	74	14.7	99	1.2
25	4.0	50	37.8	75	2.8	100	2.1

Table X

Table X

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 9

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	3.4	126	10.8	151	4.9	175	1.0
102	2.5	127	6.3	152	2.8	176	6.2
103	11.6	128	1.4	153	3.4	177	2.5
104	5.9	129	1.1	154	35.0	178	4.1
105	1.1	130	3.3	155	4.0	179	5.2
106	12.2	131	3.4	156	1.4	180	2.4
107	2.7	132	12.9	157	13.0	181	11.4
108	3.0	133	3.0	158	3.3	182	1.7
109	1.9	134	1.9	159	7.2	183	2.0
110	17.9	135	2.3	160	7.5	184	.5
111	10.9	136	1.8	161	8.0	185	9.1
112	3.1	137	1.5	162	2.3	186	5.1
113	2.2	138	8.8	163	2.2	187	1.3
114	11.7	139	3.0	164	.6	188	1.0
115	8.5	140	1.2	165	2.4	189	.8
116	2.4	141	20.4	166	2.9	190	2.0
117	1.1	142	1.9	167	2.0	191	.5
118	21.7	143	17.7	168	2.3	192	1.1
119	1.4	144	3.6	169	1.3	193	6.9
120	1.3	145	16.9	170	2.0	194	2.5
121	2.2	146	2.6	171	3.8	195	1.2
122	.5	147	2.0	172	7.1	196	7.5
123	3.9	148	1.9	173	2.2	197	1.4
124	1.7	149	1.7	174	1.9	198	2.1
125	.6	150	2.8				

TABLE 3

TWO COMPACT NEIGHBORS (mm) FOR TEST No. 3

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	3.4	120	10.8	131	4.9	147	1.0
102	2.5	127	6.3	139	2.8	176	6.2
103	11.6	128	1.4	133	3.4	177	4.9
104	5.9	129	1.1	134	35.0	178	4.1
105	1.1	130	3.3	135	4.0	179	5.2
106	12.2	131	3.4	136	1.4	180	4.4
107	2.7	132	12.5	137	13.0	181	11.4
108	3.0	133	3.0	138	3.3	182	1.7
109	1.0	134	1.9	139	7.2	183	2.0
110	17.2	135	0.3	140	7.3	184	.9
111	10.9	136	1.8	141	8.0	185	5.1
112	3.1	137	1.3	142	8.3	186	5.3
113	2.4	138	4.8	143	5.2	187	1.3
114	11.7	139	3.0	144	.8	188	1.0
115	6.3	140	1.2	145	2.4	189	.4
116	5.4	141	20.4	146	2.3	190	5.0
117	1.1	142	1.3	147	2.0	191	.9
118	21.7	143	17.7	148	5.2	192	1.1
119	1.4	144	3.4	149	1.3	193	4.9
120	1.3	145	10.3	150	4.2	194	4.7
121	2.2	146	8.6	151	3.4	195	1.2
122	.9	147	2.0	152	7.1	196	7.3
123	3.3	148	1.3	153	2.2	197	1.4
124	1.7	149	1.7	154	1.3	198	3.1
125	.4	150	1.4				

Table XI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 10

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	18.4	26	2.2	51	6.3	76	31.1
2	5.2	27	1.5	52	4.9	77	4.0
3	15.9	28	5.0	53	4.6	78	1.0
4	19.2	29	11.5	54	3.6	79	8.0
5	21.0	30	2.3	55	.8	80	13.6
6	12.1	31	6.0	56	3.0	81	2.0
7	2.2	32	1.9	57	3.9	82	7.5
8	3.9	33	3.6	58	1.1	83	63.9
9	8.0	34	2.5	59	3.3	84	6.3
10	1.3	35	1.4	60	1.1	85	3.0
11	2.7	36	4.0	61	3.1	86	6.8
12	31.2	37	3.8	62	5.2	87	5.7
13	20.2	38	2.0	63	1.1	88	3.0
14	4.0	39	.7	64	3.2	89	54.5
15	20.3	40	4.8	65	2.3	90	4.5
16	18.5	41	1.9	66	3.4	91	7.7
17	3.2	42	2.9	67	1.9	92	22.2
18	1.0	43	5.3	68	3.4	93	4.5
19	2.4	44	2.2	69	2.7	94	6.3
20	4.6	45	1.1	70	2.6	95	5.2
21	4.1	46	4.4	71	4.9	96	1.6
22	17.7	47	9.9	72	6.3	97	10.0
23	3.9	48	3.3	73	4.3	98	6.2
24	8.2	49	1.1	74	34.6	99	3.0
25	1.7	50	3.5	75	42.6	100	2.1

Table XI

Table XI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 10

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	1.3	126	3.9	151	5.1	176	3.3
102	10.0	127	19.4	152	5.0	177	2.0
103	4.4	128	37.0	153	5.0	178	2.2
104	7.6	129	.5	154	.9	179	2.9
105	3.6	130	3.0	155	2.6	180	2.5
106	11.7	131	6.6	156	2.2	181	2.6
107	19.9	132	1.5	157	3.9	182	2.7
108	2.8	133	3.6	158	9.4	183	2.1
109	6.5	134	7.0	159	1.9	184	2.0
110	.8	135	3.2	160	3.6	185	2.0
111	3.4	136	3.2	161	1.2	186	12.0
112	20.0	137	1.3	162	1.8	187	2.3
113	3.5	138	2.9	163	8.0	188	1.3
114	6.0	139	4.1	164	2.6	189	1.8
115	12.0	140	3.9	165	.8	190	3.8
116	3.6	141	5.3	166	3.8	191	8.8
117	9.9	142	8.0	167	2.0	192	7.6
118	4.4	143	5.8	168	1.7	193	16.4
119	4.3	144	4.5	169	2.2	194	4.4
120	3.8	145	5.3	170	1.7	195	1.5
121	2.9	146	6.8	171	2.3	196	12.6
122	20.0	147	2.0	172	7.0	197	1.5
123	4.0	148	2.5	173	3.4	198	1.6
124	4.1	149	7.3	174	1.3	199	1.2
125	16.5	150	1.7	175	1.6	200	1.2

Table XX

TAPS CONTACT DISTANCES (mm) FOR TAPS No. 1 to

Table XI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 10

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	1.5	210	1.3	219	1.6	228	3.5
202	2.1	211	2.6	220	3.1	229	6.6
203	1.7	212	1.9	221	4.7	230	3.5
204	2.0	213	1.3	222	2.4	231	2.0
205	5.3	214	1.7	223	3.9	232	11.5
206	12.0	215	2.0	224	.7	233	1.9
207	3.6	216	8.1	225	3.3	234	3.2
208	1.6	217	5.7	226	4.9	235	1.9
209	5.1	218	2.7	227	9.0	236	.7

Table 12

State Contract Allowances (Rs) for Edn. No. 10

No.		No.		No.		No.	
201	1.3	212	1.3	219	1.6	228	3.4
202	5.1	211	5.4	220	3.1	229	6.8
203	1.7	212	1.9	221	4.7	230	3.9
204	6.8	213	1.3	222	5.4	231	8.0
205	3.3	214	1.7	223	3.9	232	11.5
206	12.0	215	6.6	224	.7	233	1.9
207	3.8	216	8.1	225	3.3	234	3.6
208	1.8	217	9.7	226	4.9	235	1.9
209	9.1	218	4.7	227	9.8	236	.7

Table XII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 11

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	1.7	26	1.9	51	11.7	76	4.4
2	1.3	27	2.0	52	2.0	77	2.7
3	5.0	28	1.8	53	7.8	78	4.6
4	1.9	29	2.3	54	2.9	79	1.9
5	6.9	30	1.8	55	50.7	80	2.0
6	2.7	31	2.2	56	1.6	81	6.2
7	3.3	32	1.5	57	1.3	82	6.1
8	1.7	33	3.2	58	2.0	83	1.5
9	4.5	34	3.5	59	7.5	84	3.1
10	6.3	35	1.6	60	1.1	85	5.5
11	1.6	36	1.4	61	14.7	86	1.9
12	2.0	37	17.1	62	3.0	87	.8
13	1.3	38	1.4	63	2.8	88	4.1
14	6.6	39	2.0	64	1.6	89	1.0
15	.7	40	1.5	65	9.3	90	6.3
16	1.3	41	1.5	66	1.9	91	10.6
17	2.3	42	2.0	67	1.6	92	1.5
18	7.1	43	3.3	68	2.9	93	3.8
19	1.0	44	4.3	69	.9	94	3.4
20	3.6	45	2.4	70	10.0	95	1.7
21	10.3	46	6.0	71	2.0	96	1.6
22	3.4	47	3.0	72	1.3	97	1.7
23	2.9	48	2.0	73	1.6	98	7.7
24	1.8	49	9.7	74	1.6	99	7.4
25	2.1	50	2.0	75	16.0	100	1.2

Table 11:

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 11

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	1.1	26	1.9	51	11.7	76	4.4
2	1.3	27	2.0	52	8.0	77	2.7
3	5.0	28	1.8	53	7.8	78	4.6
4	1.9	29	2.3	54	8.7	79	1.9
5	6.9	30	1.8	55	90.7	80	2.0
6	2.7	31	8.3	56	1.4	81	6.3
7	3.3	32	1.3	57	1.3	82	8.1
8	1.1	33	3.2	58	2.0	83	1.9
9	4.3	34	3.3	59	7.3	84	3.1
10	6.3	35	1.8	60	1.1	85	5.3
11	1.6	36	1.4	61	14.7	86	1.3
12	2.0	37	17.1	62	3.0	87	.8
13	1.3	38	1.4	63	2.8	88	8.1
14	6.8	39	2.0	64	1.8	89	1.0
15	.7	40	1.3	65	3.3	90	6.3
16	1.3	41	1.3	66	1.3	91	10.8
17	6.1	42	2.0	67	1.4	92	1.3
18	1.1	43	3.3	68	5.4	93	3.8
19	1.0	44	4.3	69	.3	94	3.4
20	3.8	45	2.1	70	10.1	95	1.7
21	10.3	46	8.8	71	2.0	96	1.8
22	3.4	47	3.0	72	1.3	97	1.7
23	2.8	48	2.0	73	1.8	98	7.7
24	1.2	49	3.7	74	1.8	99	7.4
25	2.1	50	2.3	75	18.4	100	1.2

Table XII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 11

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	11.0	126	6.0	151	1.5	176	1.5
102	1.7	127	3.0	152	1.0	177	3.2
103	9.8	128	13.0	153	11.5	178	1.8
104	5.2	129	1.5	154	1.2	179	14.9
105	.8	130	1.3	155	6.8	180	1.1
106	2.0	131	1.7	156	27.8	181	4.0
107	3.4	132	4.8	157	1.5	182	6.5
108	2.4	133	1.1	158	46.5	183	1.1
109	3.8	134	5.0	159	1.5	184	5.0
110	1.0	135	2.5	160	4.2	185	7.5
111	2.0	136	5.5	161	5.4	186	3.0
112	2.7	137	2.0	162	3.5	187	1.8
113	2.0	138	14.5	163	20.8	188	46.8
114	16.7	139	15.2	164	4.6	189	1.9
115	5.4	140	1.8	165	5.1	190	2.0
116	37.0	141	1.2	166	1.2	191	1.8
117	2.7	142	7.0	167	1.1	192	8.0
118	1.7	143	3.0	168	1.7	193	7.2
119	10.0	144	1.2	169	1.9	194	1.2
120	7.4	145	30.1	170	8.0	195	2.0
121	33.3	146	2.0	171	1.8	196	1.0
122	45.3	147	50.0	172	5.9	197	1.8
123	8.7	148	2.2	173	7.0	198	3.5
124	1.1	149	1.2	174	1.0	199	1.1
125	3.9	150	2.7	175	2.8	200	1.2

Table III

Table COMPACT DISTANCES (mm) FOR TAIN No. 11

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	11.3	126	6.0	151	1.5	176	1.5
102	1.1	127	3.0	152	1.0	177	3.4
103	9.8	128	13.0	153	11.5	178	1.8
104	3.2	129	1.5	154	1.5	179	14.3
105	.4	130	1.3	155	8.8	180	1.1
106	2.0	131	1.1	156	17.8	181	6.0
107	3.4	132	4.8	157	1.3	182	6.3
108	8.4	133	1.1	158	44.5	183	1.1
109	3.8	134	3.0	159	1.3	184	3.0
110	1.0	135	8.5	160	4.8	185	7.3
111	2.0	136	5.5	161	5.4	186	3.0
112	2.7	137	2.0	162	3.3	187	1.1
113	2.0	138	14.1	163	20.8	188	46.8
114	18.7	139	1.4	164	4.0	189	1.1
115	3.4	140	1.8	165	3.1	190	2.0
116	31.0	141	1.2	166	1.2	191	1.2
117	2.7	142	7.0	167	1.1	192	8.0
118	1.1	143	3.0	168	1.7	193	1.2
119	10.0	144	1.2	169	1.1	194	1.2
120	1.4	145	30.1	170	2.0	195	2.0
121	33.1	146	8.0	171	1.4	196	1.0
122	45.1	147	20.0	172	3.3	197	1.4
123	4.7	148	2.2	173	7.0	198	2.1
124	1.1	149	1.4	174	1.0	199	1.2
125	3.9	150	6.7	175	2.4	200	3.2

Table XIII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 12

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	2.3	26	19.0	51	6.7	76	2.8
2	2.6	27	8.2	52	1.1	77	3.7
3	1.5	28	5.6	53	1.8	78	.8
4	1.5	29	10.0	54	2.0	79	15.0
5	2.0	30	5.0	55	2.7	80	7.3
6	1.8	31	1.8	56	4.1	81	2.8
7	1.1	32	1.0	57	3.0	82	2.3
8	3.7	33	2.0	58	5.0	83	3.4
9	6.0	34	6.7	59	1.6	84	2.4
10	5.0	35	1.8	60	8.6	85	14.0
11	7.9	36	5.1	61	2.0	86	6.3
12	1.0	37	2.4	62	5.0	87	2.7
13	6.4	38	3.0	63	2.5	88	5.2
14	1.0	39	1.4	64	4.2	89	3.5
15	2.7	40	1.4	65	6.4	90	2.8
16	4.0	41	2.5	66	2.2	91	7.0
17	2.3	42	2.0	67	4.9	92	8.6
18	4.9	43	1.0	68	3.6	93	1.5
19	4.0	44	5.0	69	4.1	94	2.6
20	2.5	45	1.4	70	4.0	95	2.2
21	.5	46	2.3	71	10.1	96	2.1
22	1.2	47	1.4	72	4.0	97	2.2
23	8.2	48	2.0	73	6.2	98	5.1
24	5.1	49	4.7	74	2.9	99	2.0
25	3.1	50	4.4	75	5.3	100	2.4

Table XIII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 12

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	2.7	26	1.0	51	6.7	76	2.4
2	2.8	27	6.2	52	1.1	77	3.7
3	1.5	28	5.6	53	1.4	78	.4
4	1.5	29	10.6	54	6.0	79	15.0
5	2.0	30	5.0	55	6.7	80	7.2
6	1.8	31	1.4	56	4.2	81	6.8
7	1.1	32	1.4	57	3.0	82	2.2
8	3.7	33	2.6	58	5.0	83	4.4
9	6.0	34	6.7	59	1.6	84	2.4
10	5.0	35	1.8	60	6.6	85	14.0
11	7.3	36	4.1	61	3.6	86	6.3
12	1.0	37	2.4	62	5.0	87	2.7
13	6.4	38	3.0	63	2.5	88	4.2
14	1.0	39	1.4	64	4.2	89	3.5
15	2.7	40	1.4	65	6.4	90	2.8
16	4.0	41	2.5	66	2.2	91	7.0
17	2.7	42	2.0	67	4.4	92	4.6
18	4.2	43	1.0	68	7.6	93	1.4
19	4.0	44	4.0	69	4.1	94	2.6
20	2.5	45	1.0	70	4.0	95	2.2
21	.2	46	2.3	71	10.1	96	2.1
22	1.2	47	1.4	72	4.0	97	2.2
23	4.2	48	4.0	73	2.3	98	2.1
24	3.1	49	4.7	74	2.3	99	2.0
25	3.1	50	4.4	75	2.3	100	1.4

Table XIII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 12

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	21.0	110	1.6	119	13.6	128	3.6
102	2.1	111	3.0	120	1.4	129	1.5
103	4.0	112	4.7	121	2.1	130	3.2
104	1.3	113	5.1	122	2.8	131	2.4
105	2.0	114	3.2	123	3.2	132	21.4
106	8.5	115	2.7	124	1.7	133	5.8
107	18.8	116	1.7	125	18.6	134	3.3
108	4.9	117	2.8	126	17.0	135	2.1
109	1.6	118	8.2	127	1.8		

TABLE C1.1

No.		No.		No.		No.	
101	21.6	110	1.6	119	13.6	128	3.6
102	5.1	111	3.0	120	1.4	129	1.9
103	6.0	112	4.7	121	5.1	130	3.2
104	1.3	113	3.1	122	5.6	131	8.4
105	5.0	114	3.5	123	3.8	132	21.4
106	4.5	115	8.7	124	1.7	133	5.4
107	18.4	116	1.7	125	14.8	134	3.3
108	4.3	117	2.4	126	17.0	135	5.1
109	1.8	118	4.2	127	1.4		

Table XIV

TAPE CONTACT DISTANCES (mm) FOR TAPE NO. 13

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	26.7	26	13.2	51	1.3	76	7.1
2	34.6	27	9.7	52	4.2	77	4.4
3	10.5	28	4.9	53	2.5	78	1.9
4	4.9	29	2.7	54	1.5	79	2.1
5	1.5	30	3.6	55	1.4	80	5.0
6	5.8	31	3.9	56	5.7	81	2.5
7	5.8	32	6.8	57	5.1	82	3.8
8	5.0	33	25.6	58	11.8	83	11.7
9	2.1	34	.9	59	2.7	84	1.7
10	2.1	35	6.1	60	5.1	85	2.1
11	8.2	36	2.4	61	3.6	86	10.5
12	3.9	37	8.5	62	2.2	87	1.2
13	2.2	38	1.5	63	3.0	88	1.9
14	5.5	39	4.3	64	1.1	89	5.0
15	1.6	40	2.1	65	4.0	90	2.8
16	2.0	41	7.3	66	2.4	91	3.0
17	18.3	42	4.2	67	14.0	92	2.4
18	4.5	43	6.3	68	3.4	93	1.7
19	32.6	44	17.2	69	4.4	94	5.5
20	3.8	45	3.4	70	8.0	95	3.1
21	12.1	46	10.4	71	2.1	96	3.0
22	3.0	47	3.8	72	3.7	97	.8
23	3.2	48	3.2	73	2.4	98	4.0
24	2.0	49	2.0	74	2.0	99	1.7
25	2.0	50	2.2	75	17.0	100	1.7

Table XIV

Table contact distances (mm) for Table No. 13

No.	Distance	No.	Distance	No.	Distance	No.	Distance
1	26.7	26	12.2	51	1.3	76	7.1
2	24.6	27	9.7	52	4.2	77	4.4
3	10.5	28	4.5	53	2.5	78	1.4
4	4.5	29	1.7	54	1.3	79	2.1
5	1.5	30	3.6	55	1.4	80	3.0
6	3.8	31	3.9	56	3.7	81	5.9
7	5.6	32	6.4	57	5.1	82	3.8
8	5.0	33	25.6	58	11.8	83	11.7
9	5.1	34	.9	59	2.7	84	1.7
10	2.1	35	8.1	60	5.1	85	2.1
11	6.2	36	2.4	61	3.8	86	10.5
12	3.3	37	8.5	62	2.2	87	1.2
13	2.2	38	1.5	63	3.4	88	1.9
14	3.3	39	4.3	64	1.1	89	5.0
15	1.6	40	2.1	65	4.0	90	2.4
16	2.0	41	7.3	66	3.4	91	3.0
17	18.3	42	4.2	67	14.6	92	2.4
18	4.5	43	6.3	68	3.4	93	1.7
19	32.6	44	17.2	69	4.4	94	5.5
20	3.8	45	3.4	70	8.0	95	3.1
21	12.1	46	10.4	71	2.1	96	3.0
22	3.0	47	3.8	72	3.7	97	.3
23	3.8	48	3.2	73	1.4	98	4.0
24	2.0	49	2.0	74	4.6	99	1.7
25	2.0	50	2.2	75	17.6	100	1.7

Table XIV

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 13

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	3.7	118	4.0	134	16.8	150	1.2
102	1.1	119	8.3	135	4.9	151	2.1
103	8.8	120	2.0	136	16.3	152	5.7
104	11.7	121	9.7	137	2.9	153	1.3
105	3.8	122	2.8	138	8.7	154	6.8
106	12.9	123	3.5	139	2.7	155	2.6
107	1.7	124	2.0	140	2.0	156	2.1
108	3.3	125	3.2	141	1.4	157	1.7
109	2.8	126	5.8	142	2.7	158	2.5
110	2.4	127	1.8	143	1.0	159	5.4
111	1.0	128	2.6	144	4.2	160	.9
112	.6	129	5.0	145	4.9	161	3.8
113	4.7	130	5.2	146	7.3	162	2.0
114	2.2	131	15.0	147	7.3	163	1.0
115	0.0	132	6.8	148	1.4	164	3.6
116	13.5	133	1.2	149	2.8	165	1.5
117	13.5						

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	7.7	118	4.0	134	18.8	150	1.2
102	1.1	119	8.3	135	4.9	151	0.1
103	8.8	120	2.0	136	16.3	152	3.1
104	11.7	121	9.7	137	2.9	153	1.3
105	3.8	122	6.4	138	1.7	154	4.4
106	19.9	123	3.1	139	6.7	155	2.4
107	1.7	124	2.0	140	5.0	156	2.1
108	3.3	125	3.2	141	1.4	157	1.7
109	5.8	126	3.6	142	2.7	158	4.3
110	6.4	127	1.4	143	1.0	159	3.4
111	1.0	128	3.6	144	4.2	160	.3
112	.4	129	3.6	145	4.3	161	3.6
113	4.7	130	3.2	146	1.3	162	2.0
114	5.2	131	12.0	147	7.3	163	1.0
115	6.0	132	0.8	148	1.4	164	3.6
116	13.3	133	1.2	149	2.2	165	1.0
117	13.3						

TABLE OF DISTANCES (cms) FOR MAP No. 13

Table XV

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 14

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	2.2	26	12.9	51	3.0	76	22.3
2	4.6	27	57.3	52	3.4	77	30.0
3	5.0	28	18.0	53	18.0	78	3.9
4	14.8	29	7.3	54	1.4	79	4.0
5	9.2	30	13.8	55	8.0	80	4.9
6	7.6	31	4.8	56	2.7	81	13.2
7	1.8	32	2.9	57	7.3	82	8.5
8	1.9	33	7.0	58	1.2	83	19.4
9	15.0	34	2.0	59	3.9	84	4.0
10	6.9	35	1.8	60	5.2	85	1.8
11	4.7	36	4.8	61	7.2	86	7.7
12	3.0	37	3.9	62	8.4	87	6.7
13	.7	38	1.8	63	5.1	88	7.0
14	3.1	39	3.6	64	16.3	89	1.0
15	7.4	40	3.9	65	22.9	90	11.5
16	15.5	41	1.3	66	37.4	91	6.9
17	2.9	42	10.0	67	5.1	92	7.0
18	15.7	43	35.7	68	4.5	93	6.4
19	9.2	44	4.2	69	2.9	94	8.0
20	5.0	45	3.1	70	8.8	95	8.0
21	27.0	46	4.1	71	2.0	96	1.6
22	15.8	47	3.3	72	11.2	97	2.1
23	42.0	48	3.5	73	8.9	98	12.1
24	3.0	49	8.0	74	6.3	99	2.5
25	10.0	50	3.8	75	7.0	100	7.0

Table XV

TAXI CONTACT DISTANCES (km) FOR TAXI No. 14

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	6.4	26	12.9	51	3.0	76	22.3
2	4.0	27	31.3	52	3.4	77	30.0
3	3.0	28	14.8	53	12.8	78	3.9
4	14.8	29	7.3	54	1.4	79	4.0
5	3.2	30	13.8	55	8.0	80	4.9
6	7.8	31	4.8	56	2.7	81	13.2
7	1.8	32	2.9	57	7.3	82	6.3
8	1.9	33	7.0	58	1.2	83	13.4
9	15.0	34	2.0	59	3.9	84	4.0
10	6.9	35	1.8	60	3.2	85	1.8
11	4.1	36	4.8	61	7.2	86	7.7
12	3.0	37	3.9	62	8.4	87	0.7
13	.7	38	1.8	63	5.1	88	7.0
14	3.1	39	3.0	64	16.3	89	1.0
15	7.4	40	3.8	65	29.4	90	11.9
16	15.3	41	1.3	66	37.4	91	8.8
17	8.9	42	10.8	67	9.1	92	7.0
18	13.7	43	35.1	68	4.3	93	8.4
19	9.1	44	4.2	69	2.8	94	4.0
20	5.0	45	3.1	70	8.1	95	8.0
21	27.0	46	4.1	71	0.1	96	1.6
22	15.8	47	3.8	72	11.4	97	9.1
23	42.4	48	3.1	73	8.9	98	12.1
24	3.0	49	8.0	74	8.3	99	2.5
25	24.4	50	3.8	75	7.4	100	7.4

Table XV

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 14

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	3.2	119	5.0	136	4.5	153	10.2
102	1.8	120	4.1	137	6.6	154	6.5
103	9.5	121	8.5	138	2.9	155	4.4
104	9.9	122	5.2	139	13.2	156	3.2
105	5.0	123	26.5	140	1.8	157	3.4
106	7.9	124	6.0	141	2.9	158	3.0
107	10.0	125	16.0	142	22.9	159	8.9
108	3.2	126	15.5	143	3.5	160	9.0
109	10.9	127	3.3	144	4.3	161	27.9
110	14.9	128	9.8	145	1.1	162	7.0
111	8.6	129	1.2	146	12.9	163	3.0
112	37.6	130	6.0	147	14.8	164	1.7
113	11.5	131	10.8	148	2.0	165	4.3
114	49.9	132	4.9	149	6.1	166	3.1
115	9.5	133	3.0	150	2.1	167	3.9
116	14.8	134	3.6	151	47.6	168	40.1
117	8.0	135	4.0	152	10.0	169	4.1
118	12.3						

Table IX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 14

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	3.2	119	5.0	137	9.3	155	10.4
102	1.6	120	6.1	137	6.6	154	6.6
103	9.5	121	8.5	138	8.9	155	6.4
104	9.9	122	5.2	139	13.2	156	3.8
105	5.0	123	26.5	140	1.6	157	3.4
106	7.9	124	6.0	141	8.9	158	3.0
107	10.0	125	12.0	142	22.9	159	4.3
108	3.2	126	13.5	143	3.9	160	9.0
109	10.9	127	3.3	144	4.3	161	27.5
110	14.9	128	9.8	145	1.1	162	7.0
111	4.6	129	1.5	146	12.3	163	3.0
112	37.0	130	6.0	147	14.8	164	1.7
113	11.3	131	10.8	148	2.0	165	4.7
114	49.9	132	4.3	149	1.3	166	3.1
115	9.5	133	3.0	150	8.1	167	3.3
116	14.8	134	3.8	151	47.6	168	40.1
117	4.0	135	4.0	152	12.4	169	4.3
118	12.3						

Table XVI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 15

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	5.1	26	4.7	51	9.0	76	25.0
2	5.0	27	3.5	52	7.0	77	8.3
3	4.0	28	5.0	53	16.8	78	19.2
4	1.4	29	11.3	54	11.5	79	2.6
5	2.2	30	8.3	55	1.2	80	3.5
6	9.3	31	6.1	56	2.0	81	.6
7	5.0	32	33.0	57	8.2	82	2.5
8	18.8	33	8.0	58	3.6	83	1.0
9	3.0	34	1.3	59	45.0	84	4.0
10	4.8	35	7.0	60	23.3	85	21.8
11	6.1	36	7.0	61	20.9	86	6.9
12	4.7	37	5.1	62	17.6	87	2.0
13	28.7	38	1.4	63	7.5	88	56.5
14	5.2	39	8.4	64	6.5	89	9.9
15	4.7	40	5.5	65	4.6	90	10.3
16	2.7	41	5.2	66	11.5	91	14.0
17	9.0	42	3.9	67	8.0	92	8.6
18	3.2	43	17.0	68	11.2	93	21.6
19	1.1	44	9.0	69	11.0	94	18.7
20	25.3	45	37.3	70	24.7	95	8.8
21	8.4	46	14.0	71	6.7	96	5.6
22	2.0	47	5.3	72	10.3	97	6.5
23	5.4	48	5.5	73	7.4	98	2.5
24	4.7	49	6.0	74	15.1	99	6.0
25	7.0	50	2.2	75	7.3	100	3.3

Table XVI

[illegible] (cm) for Test No. 12

No.		No.		No.		No.	
1	3.1	26	4.7	51	1.0	76	85.4
2	5.0	27	3.5	52	1.9	77	6.3
3	4.0	28	4.0	53	24.8	78	134.7
4	1.4	29	11.3	54	117.3	79	2.6
5	3.2	30	8.3	55	3.2	80	3.3
6	4.3	31	0.1	56	4.0	81	.4
7	3.0	32	332.0	57	8.3	82	8.3
8	12.8	33	8.0	58	3.0	83	1.0
9	3.0	34	1.3	59	452.0	84	.4
10	4.4	35	7.4	60	213.3	85	21.2
11	8.1	36	4.0	61	204.7	86	6.2
12	4.7	37	3.1	62	17.6	87	2.0
13	24.1	38	1.4	63	7.5	88	362.3
14	3.2	39	8.4	64	8.5	89	3.3
15	4.7	40	3.3	65	4.4	90	20.3
16	9.7	41	3.2	66	11.3	91	14.0
17	8.2	42	3.3	67	8.0	92	4.7
18	3.2	43	12.0	68	11.2	93	22.4
19	1.1	44	3.0	69	11.-	94	18.7
20	23.3	45	32.3	70	4.7	95	4.2
21	4.4	46	1.0	71	.7	96	.4
22	2.0	47	2.-	72	14.3	97	0.3
23	4.4	48	3.3	73	7.4	98	1.3
24	4.1	49	8.0	74	13.2	99	0.0
25	7.0	50	4.5	75	7.3	100	3.3

Table XVI

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 15

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	4.6	111	4.7	121	9.8	131	18.2
102	32.6	112	5.3	122	5.3	132	40.0
103	88.4	113	47.2	123	7.1	133	40.9
104	2.0	114	8.6	124	4.0	134	5.0
105	5.1	115	10.0	125	10.4	135	28.5
106	3.9	116	2.2	126	20.0	136	13.2
107	5.5	117	10.8	127	84.4	137	10.2
108	5.4	118	4.7	128	22.5	138	13.3
109	18.8	119	18.3	129	9.0	139	5.4
110	10.5	120	8.0	130	5.0	140	12.5

Table VI

TAPE CONTACT CLEARANCE (mm) FOR TAPE No. 15

No.	CLEARANCE	No.	CLEARANCE	No.	CLEARANCE	No.	CLEARANCE
101	4.6	111	4.7	121	3.4	131	18.2
102	13.6	112	5.3	122	5.2	132	40.0
103	88.4	113	47.8	123	7.1	133	40.2
104	2.0	114	8.6	124	4.4	134	3.0
105	3.1	115	10.0	125	14.4	135	28.1
106	3.9	116	8.2	126	20.0	136	13.2
107	3.5	117	10.8	127	84.4	137	10.2
108	3.4	118	4.7	128	22.5	138	13.3
109	16.1	119	10.3	129	3.0	139	3.4
110	10.5	120	6.0	130	3.4	140	12.3

Table XVII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 16

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	2.7	12	2.4	23	24.9	33	15.0
2	10.0	13	1.5	24	21.0	34	7.7
3	5.3	14	4.5	25	4.5	35	7.4
4	6.3	15	5.0	26	2.6	36	2.0
5	1.6	16	8.1	27	25.8	37	5.3
6	2.9	17	8.9	28	6.2	38	4.5
7	3.0	18	3.2	29	4.0	39	11.6
8	7.9	19	2.9	30	15.6	40	8.6
9	4.6	20	3.5	31	5.8	41	56.8
10	7.9	21	3.5	32	6.0	42	15.6
11	15.7	22	4.0				

Table XVIII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 17

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	2.6	26	5.8	51	4.1	76	10.2
2	3.3	27	8.1	52	10.9	77	8.9
3	.5	28	6.0	53	5.6	78	2.1
4	34.7	29	4.0	54	2.4	79	5.8
5	5.7	30	2.3	55	3.7	80	2.1
6	12.1	31	3.7	56	8.8	81	1.7
7	4.5	32	3.9	57	7.4	82	8.8
8	1.9	33	5.1	58	8.5	83	3.3
9	3.8	34	22.9	59	4.0	84	5.0
10	3.7	35	11.8	60	6.3	85	.5
11	4.3	36	9.0	61	4.2	86	3.3
12	.8	37	2.3	62	10.5	87	5.4
13	21.0	38	2.0	63	4.7	88	4.7
14	10.8	39	.5	64	2.3	89	7.0
15	24.9	40	3.8	65	3.7	90	4.9
16	5.5	41	2.5	66	11.0	91	3.8
17	2.7	42	1.9	67	2.1	92	5.9
18	2.4	43	1.0	68	9.0	93	9.2
19	2.8	44	12.3	69	3.5	94	6.2
20	1.2	45	2.8	70	4.1	95	2.2
21	5.7	46	8.8	71	1.8	96	7.1
22	3.6	47	2.2	72	1.0	97	5.6
23	8.8	48	2.8	73	2.2	98	3.4
24	2.0	49	8.3	74	9.9	99	27.7
25	2.7	50	2.0	75	10.3	100	20.4

Table XVIII

TAXI CONTACT DISTANCES (mi) FOR TAXI No. 17

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	2.6	26	5.8	51	6.1	76	10.3
2	3.5	27	4.1	52	10.9	77	8.9
3	.5	28	6.4	53	5.6	78	2.1
4	24.7	29	4.0	54	3.4	79	5.8
5	5.7	30	2.3	55	3.7	80	2.1
6	12.1	31	3.7	56	8.8	81	1.7
7	4.5	32	3.9	57	7.4	82	6.8
8	1.9	33	5.1	58	4.5	83	3.3
9	3.8	34	22.9	59	4.0	84	5.6
10	3.7	35	11.8	60	6.3	85	.5
11	4.3	36	3.6	61	4.2	86	3.3
12	.8	37	1.5	62	10.3	87	3.8
13	21.0	38	2.0	63	4.7	88	4.7
14	10.8	39	.5	64	2.3	89	7.0
15	24.9	40	3.8	65	3.7	90	4.3
16	5.5	41	2.5	66	11.0	91	3.8
17	2.7	42	1.9	67	2.3	92	5.9
18	2.4	43	1.0	68	9.0	93	4.2
19	2.8	44	12.3	69	3.9	94	6.2
20	1.3	45	2.4	70	4.1	95	2.2
21	5.7	46	8.8	71	1.8	96	7.1
22	3.6	47	2.2	72	1.0	97	3.6
23	7.8	48	2.4	73	8.2	98	3.4
24	3.0	49	6.3	74	9.9	99	27.1
25	2.7	50	2.0	75	4.3	100	20.9

Table XVIII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 17

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	7.0	126	3.7	151	38.0	176	89.3
102	5.5	127	2.6	152	2.5	177	36.5
103	7.0	128	2.0	153	15.3	178	17.1
104	31.9	129	2.8	154	17.3	179	2.3
105	5.7	130	2.8	155	4.0	180	5.3
106	3.9	131	4.6	156	4.6	181	7.2
107	2.0	132	2.2	157	8.8	182	2.4
108	4.2	133	3.9	158	1.0	183	3.5
109	24.8	134	4.3	159	7.0	184	2.0
110	5.5	135	2.4	160	6.0	185	12.4
111	6.0	136	2.1	161	3.7	186	2.4
112	8.3	137	9.3	162	7.9	187	8.2
113	11.9	138	9.5	163	1.8	188	4.0
114	12.0	139	3.9	164	2.1	189	3.4
115	3.5	140	5.0	165	1.2	190	14.2
116	5.4	141	12.2	166	7.0	191	5.3
117	6.9	142	5.0	167	5.7	192	3.6
118	4.1	143	.8	168	4.0	193	7.4
119	8.0	144	3.8	169	11.0	194	19.2
120	.7	145	5.9	170	5.6	195	2.4
121	5.0	146	2.4	171	110.7	196	4.4
122	.5	147	3.2	172	.5	197	2.9
123	5.9	148	11.9	173	21.6	198	2.0
124	.4	149	5.3	174	3.8	199	9.4
125	7.2	150	22.2	175	25.7	200	3.8

TABLE XVIII

CASE CONTACT DISTANCES (MM) FOR CASE NO. 17

No.	No.	No.	No.	No.	No.
101	126	3.7	151	34.0	176
102	127	4.0	152	8.5	177
103	128	4.0	153	14.3	178
104	129	4.6	154	17.3	179
105	130	4.8	155	8.0	180
106	131	4.5	156	4.6	181
107	132	5.2	157	8.8	182
108	133	3.9	158	1.0	183
109	134	4.3	159	7.0	184
110	135	4.4	160	6.0	185
111	136	5.1	161	3.7	186
112	137	3.5	162	7.9	187
113	138	4.3	163	1.8	188
114	139	3.9	164	5.1	189
115	140	5.0	165	1.4	190
116	141	15.5	166	7.0	191
117	142	3.0	167	3.7	192
118	143	4.0	168	4.0	193
119	144	3.4	169	11.0	194
120	145	3.4	170	3.4	195
121	146	5.4	171	111.1	196
122	147	3.3	172	5.	197
123	148	11.3	173	34.0	198
124	149	3.3	174	3.8	199
125	150	54.3	175	70.1	200

Table XVIII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 17

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	5.6	220	22.6	239	6.0	258	4.0
202	3.9	221	2.1	240	4.0	259	4.0
203	8.9	222	2.4	241	5.7	260	.7
204	7.0	223	5.4	242	2.2	261	9.3
205	1.7	224	6.2	243	1.9	262	3.8
206	6.3	225	4.0	244	2.6	263	1.7
207	5.2	226	4.0	245	1.0	264	2.0
208	7.3	227	5.7	246	1.6	265	10.9
209	2.8	228	6.0	247	6.0	266	3.6
210	7.0	229	22.0	248	4.7	267	1.7
211	2.8	230	5.9	249	11.0	268	5.9
212	4.0	231	4.0	250	6.0	269	5.7
213	7.3	232	16.0	251	24.0	270	4.0
214	3.5	233	4.0	252	10.5	271	3.0
215	7.0	234	9.0	253	7.2	272	3.8
216	4.7	235	10.5	254	4.0	273	1.5
217	.8	236	10.7	255	2.7	274	3.7
218	8.3	237	4.3	256	3.5	275	8.8
219	27.6	238	5.6	257	3.8	276	.9

TABLE XVIII

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 17

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	4.0	220	262.8	239	6.8	258	4.0
202	3.9	221	8.1	240	6.0	259	6.0
203	4.9	222	8.4	241	5.7	260	.7
204	7.0	223	5.0	242	5.8	261	9.3
205	1.7	224	6.2	243	1.9	262	3.8
206	6.3	225	8.0	244	2.0	263	1.1
207	5.2	226	8.0	245	1.0	264	2.0
208	7.3	227	5.7	246	1.6	265	104.9
209	2.8	228	6.0	247	6.0	266	3.8
210	7.0	229	80.0	248	6.7	267	1.7
211	6.8	230	5.9	249	12.0	268	5.9
212	4.0	231	4.0	250	6.6	269	5.7
213	7.3	232	10.0	251	24.0	270	4.0
214	5.5	233	8.0	252	10.5	271	3.0
215	7.0	234	9.0	253	7.8	272	3.8
216	4.7	235	10.5	254	4.0	273	1.9
217	.8	236	10.7	255	8.7	274	3.7
218	4.3	237	9.3	256	8.4	275	8.8
219	27.6	238	5.6	257	3.8	276	.9

Table XIX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 18

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
1	5.3	26	2.6	51	10.1	76	8.2
2	5.0	27	5.7	52	13.9	77	8.0
3	2.2	28	4.3	53	9.0	78	5.3
4	4.9	29	2.0	54	8.8	79	2.4
5	3.2	30	1.6	55	10.8	80	1.5
6	3.5	31	2.0	56	2.3	81	17.0
7	14.3	32	8.6	57	7.0	82	5.2
8	21.1	33	6.6	58	7.1	83	14.0
9	37.2	34	6.3	59	4.0	84	9.2
10	7.4	35	8.0	60	3.3	85	3.3
11	7.4	36	2.2	61	2.3	86	13.6
12	4.1	37	3.6	62	4.9	87	119.9
13	24.0	38	23.0	63	3.7	88	81.0
14	56.6	39	.9	64	12.5	89	9.8
15	6.0	40	8.9	65	2.4	90	24.7
16	4.5	41	.9	66	2.0	91	49.4
17	5.3	42	13.0	67	4.5	92	8.9
18	13.1	43	9.4	68	8.0	93	2.3
19	3.0	44	6.2	69	11.0	94	2.4
20	16.9	45	5.4	70	13.5	95	5.6
21	9.0	46	14.4	71	5.9	96	3.3
22	10.0	47	3.2	72	2.3	97	3.7
23	60.3	48	1.3	73	8.2	98	9.0
24	2.2	49	7.8	74	6.7	99	28.5
25	5.6	50	2.1	75	12.3	100	4.6

TABLE 4.5.5

No.		No.		No.		No.	
1	5.3	28	8.5	55	120.1	82	8.2
2	9.0	27	5.7	56	139.9	77	8.0
3	5.2	26	4.3	53	9.0	78	5.3
4	4.9	29	8.0	54	8.8	79	5.4
5	3.2	30	1.6	55	120.8	80	1.5
6	3.3	31	8.0	56	2.3	83	117.0
7	104.3	32	8.8	57	7.0	84	5.2
8	21.1	33	8.8	58	7.1	85	104.0
9	37.3	34	8.3	59	4.0	86	9.2
10	7.4	35	8.0	60	3.3	88	3.3
11	7.4	36	8.2	61	2.3	46	13.5
12	4.1	37	5.0	62	4.3	87	119.3
13	24.0	38	13.0	63	3.7	84	82.0
14	36.0	39	.3	64	12.3	89	1.4
15	8.0	40	4.3	65	2.4	90	24.7
16	4.3	41	.3	66	2.0	91	43.4
17	3.3	42	13.0	67	4.3	39	8.3
18	13.2	43	3.4	68	8.0	93	3.1
19	3.0	44	8.2	69	11.3	94	2.4
20	12.3	45	5.4	70	13.3	95	3.8
21	3.0	46	14.4	71	5.8	96	3.3
22	10.0	47	3.2	72	8.3	97	3.7
23	80.3	48	1.3	73	8.2	98	3.0
24	2.2	49	7.8	74	8.7	99	23.8
25	3.4	50	2.1	75	12.3	100	4.6

Table XIX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 18

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
101	2.0	126	14.0	151	1.7	176	9.0
102	7.5	127	3.3	152	4.4	177	9.0
103	5.5	128	9.0	153	7.3	178	4.0
104	5.9	129	7.3	154	1.8	179	42.7
105	4.5	130	8.6	155	9.7	180	7.6
106	9.6	131	6.3	156	5.4	181	3.0
107	6.0	132	20.0	157	4.1	182	2.2
108	19.0	133	26.0	158	22.8	183	15.7
109	20.9	134	3.0	159	2.6	184	22.9
110	4.0	135	7.4	160	7.2	185	2.5
111	3.2	136	8.7	161	7.2	186	2.5
112	2.3	137	5.5	162	19.4	187	199.0
113	3.8	138	1.2	163	21.1	188	10.6
114	7.4	139	7.0	164	4.0	189	8.8
115	5.2	140	6.4	165	21.4	190	5.8
116	8.3	141	2.2	166	24.0	191	2.0
117	3.5	142	3.8	167	30.7	192	38.2
118	17.7	143	15.5	168	7.7	193	9.5
119	7.1	144	4.0	169	2.6	194	21.2
120	16.0	145	5.4	170	12.9	195	17.3
121	7.6	146	8.0	171	22.9	196	5.7
122	21.1	147	7.4	172	9.0	197	3.6
123	7.0	148	12.0	173	17.9	198	14.4
124	2.3	149	6.0	174	22.4	199	6.2
125	4.0	150	2.0	175	24.2	200	4.2

TABLE XIX

TAPE CONTENTS STATISTICS (MO) FOR DISC NO. 18/

No.						
101	5.0	152	34.0	153	1.4	176
102	7.5	124	1.8	152	6.4	111
103	34.5	144	3.0	153	7.3	178
104	3.5	158	1.3	154	11.0	179
105	4.1	138	8.0	155	31.4	180
106	3.4	173	0.2	156	24.4	181
107	5.0	132	20.0	157	41.1	182
108	18.0	172	20.0	158	22.8	183
109	25.0	134	3.0	159	5.0	184
110	4.0	135	1.4	160	7.2	185
111	3.0	136	0.7	161	1.2	186
112	5.2	137	3.3	162	170.4	187
113	3.4	138	1.0	163	61.1	188
114	1.4	139	1.0	164	6.0	189
115	3.5	140	0.4	165	21.4	190
116	4.3	141	5.5	166	50.0	191
117	3.0	142	3.0	167	34.1	192
118	17.1	143	13.3	168	7.1	193
119	1.1	144	4.0	169	6.0	194
120	15.0	145	3.4	170	135.3	195
121	3.5	146	0.4	171	3.0	196
122	2.6	147	0.4	172	12.3	197
123	1.0	148	12.0	173	1.3	198
124	13.1	149	7.4	174	1.0	199
125	4.0	150	0.0	175	32.4	200

Table XIX

TAPE CONTACT DISTANCES (mm) FOR TAPE No. 18

No.	DISTANCE	No.	DISTANCE	No.	DISTANCE	No.	DISTANCE
201	5.4	219	3.2	236	6.0	253	9.0
202	4.1	220	5.0	237	40.5	254	40.6
203	2.1	221	14.1	238	3.8	255	23.0
204	2.6	222	4.2	239	4.0	256	15.7
205	19.0	223	1.0	240	10.0	257	7.5
206	12.5	224	2.6	241	4.0	258	2.2
207	6.0	225	3.8	242	17.5	259	4.4
208	2.0	226	1.9	243	3.9	260	10.4
209	2.2	227	26.0	244	13.7	261	2.5
210	2.5	228	98.0	245	4.0	262	2.5
211	6.0	229	5.6	246	14.6	263	21.0
212	1.8	230	9.2	247	4.7	264	7.0
213	3.9	231	6.9	248	1.0	265	3.7
214	3.7	232	7.3	249	4.0	266	5.5
215	4.4	233	2.6	250	3.2	267	2.4
216	2.3	234	2.0	251	34.3	268	6.0
217	1.7	235	2.3	252	69.3	269	3.4
218	10.8						

Table No.

No.		No.		No.		No.	
201	3.6	214	3.2	236	4.0	253	0.0
202	4.1	220	5.0	237	40.3	254	40.6
203	2.1	222	14.1	238	3.8	255	23.0
204	3.6	226	4.2	239	4.0	256	15.7
205	14.0	227	1.0	240	10.0	257	7.5
206	12.5	228	6.6	241	4.4	258	1.2
207	8.0	229	3.6	242	17.3	259	4.1
208	2.0	230	1.9	243	3.9	260	10.4
209	4.2	231	30.0	244	13.7	261	2.5
210	4.5	232	34.0	245	4.0	262	2.5
211	6.0	233	3.0	246	14.6	263	11.0
212	1.2	234	3.2	247	4.7	264	7.0
213	3.3	235	6.3	248	1.0	265	3.7
214	3.7	236	7.3	249	4.0	266	5.3
215	4.4	237	2.6	250	1.2	267	2.4
216	2.3	238	2.0	251	34.3	268	0.0
217	1.7	239	2.3	252	30.3	269	3.4
218	10.3						

APPENDIX E

Tabulated Distribution of Contact Areas

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Table XX. Table of Contact Area Distribution for All Tapes .....A 54

Table XXI. Table of Contact Area Distribution for Tape 8 .....A 55

APPENDIX A

Tabulated Identification of Goodness Curves

Table I. Table of Goodness and Identification
for 477 Images 34

Table II. Table of Confused and Identification
for the Image 0 35

Table XX

TABLE OF CONTACT AREA DISTRIBUTION FOR ALL TAPES

Contact Area ($cm^2 x 10^{-8}$)	Mean Area ($cm^2 x 10^{-8}$)	No. of Contacts	Contact Area ($cm^2 x 10^{-8}$)	Mean Area ($cm^2 x 10^{-8}$)	No. of Contacts
0			146.0		
	7.3	2524		153.3	4
14.6			160.6		
	21.9	155		167.9	3
29.2			175.2		
	36.5	69		182.5	3
43.8			189.8		
	51.1	39		197.1	4
58.4			204.4		
	65.7	29		211.7	5
73.0			219.0		
	80.3	7		226.3	3
87.6			233.6		
	94.9	10		240.9	3
102.2			248.2		
	109.5	12		255.5	2
116.8			262.8		
	124.1	8		270.1	2
131.4					
	138.7	8		284.7	3

DISTRIBUTION OF CONTACT AREAS LESS THAN $14.6 x 10^{-8} cm^2$

Contact Area ($cm^2 x 10^{-8}$)	Mean Area ($cm^2 x 10^{-8}$)	No. of Contacts	Contact Area ($cm^2 x 10^{-8}$)	Mean Area ($cm^2 x 10^{-8}$)	No. of Contacts
0			7.30		
	.73	1553		8.03	54
1.46			8.76		
	2.19	417		9.49	48
2.92			10.22		
	3.65	178		10.95	30
4.38			11.68		
	5.11	100		12.41	19
5.84			13.14		
	6.55	90		13.87	30
7.30			14.60		

Table E3

TABLE OF CONTOUR AREA STATISTICS FOR ALL TAPES

Contour Area ($cm^2 x10^{-6}$)	Mean Area ($cm^2 x10^{-6}$)	No. of Contours	Contour Area ($cm^2 x10^{-6}$)	Mean Area ($cm^2 x10^{-6}$)	No. of Contours
0			146.0		
	7.3	8548		133.4	4
14.6			116.6		
	23.3	158		107.8	2
29.2			175.2		
	36.5	88		100.4	2
43.4			160.8		
	51.1	39		137.2	4
58.4			204.4		
	65.7	29		273.7	3
73.0			611.0		
	No.3	7		159.1	3
87.6			433.6		
	94.9	12		340.8	3
102.2			464.2		
	109.5	12		523.4	3
116.4			584.4		
	124.1	8		470.1	2
131.4					
	138.7	8		188.7	3

DISTRIBUTION OF CONTOUR AREAS LESS THAN $14.6x10^{-6}$ cm^2

Contour Area ($cm^2 x10^{-6}$)	Mean Area ($cm^2 x10^{-6}$)	No. of Contours	Contour Area ($cm^2 x10^{-6}$)	Mean Area ($cm^2 x10^{-6}$)	No. of Contours
0			7.30		
	.73	13958		8.93	94
1.46			8.76		
	5.19	417		9.49	44
2.92			10.22		
	3.65	178		10.95	24
4.38			11.68		
	4.11	100		12.41	14
5.84			13.14		
	6.57	80		13.87	20
7.30			14.60		

Table XXI

CALCULATIONS TO OBTAIN DIAMETER OF AVERAGE CONTACT AREA FOR TAPE No. 8

D	N	$(D/2)^2$	$(D/2)^2N$	D	N	$(D/2)^2$	$(D/2)^2N$
0	258	12.5		0	148	1.3	192
10.0				3.2			
	27	37.5	101		30	3.8	114
14.1				4.5			
	20	62.5	125		24	6.3	151
17.3				5.5			
	7	87.5	612		22	8.8	193
20.0				6.3			
	6	112.5	675		15	11.3	170
22.4				7.1			
	3	137.5	413		8	13.8	110
24.5				7.7			
	3	162.5	488		8	16.3	130
26.4				8.4			
	4	187.5	751		1	18.8	19
28.3				8.9			
	4	212.5	848		1	21.3	21
30.0				9.5			
	3	237.5	712		1	23.8	24
31.6				10.0			
	1	262.5	263				
33.2					258		1124
	1	287.5	287				
34.6							
	0	312.5	0				
36.0							
	1	337.5	338	46.9	1	550	550
37.4							
	2	362.5	725	47.8	1	572	572
38.7							
	2	387.5	775	55.2	1	762	762
40.0							
	1	412.5	412	60.0	1	900	900
41.2							
	2	437.5	875	72.2	1	1320	1320
42.4							
	1	462.5	462	81.4	1	1660	1660
43.6							
	1	487.5	488		6		5764
44.7							
	347		9350				

APPENDIX F

Sample Calculations

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I. Average Diameter of Contacts for Tape 8 .....A 57

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APPENDIX B

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SAMPLE CALCULATIONS

Average diameter of the contact areas for Tape 8

The data for Tape 8 is given in Tables 1 and 9.

ΣN = total number of contacts = 353

Σd = sum of all contact tape distances = 3,060.5mm

$\bar{d}$ = average contact tape distance

$\bar{d} = \Sigma N/\Sigma d$ = 3,060.5/353 = 8.675mm

Tape speed = 100mm/sec.

Crossing speed = $r\Omega$

where: r = distance from center of rotation of the slider to the probe contact wire in mm.

Ω = angular velocity of the slider in radians/sec.

Crossing speed = (1.2 x 25.4) (24/441)(π/60) = .0868mm/sec.

d_d = average diameter of the contact areas

$$d_d = \frac{\bar{d} \text{ x(crossing speed)}}{2 \text{ x(tape speed)}} = \frac{8.675(.0868)}{2 \text{ x}(100)} = 3.77 \times 10^{-4} \text{cm.}$$

Analysis Calculations

Average Diameter of the Cookware

Areas for Type E

The data for Type E is given in Tables 1 and 9.

ΣE = total number of workpcs = 397

ΣA = sum of all nominal hole diameters = 3,260.5mm

$\bar{d}$ = average nominal hole diameter

$\bar{d} = \Sigma A / \Sigma E = 3,260.5/397 = 8.21mm$

Cookware speed = 1.5Ω

where: P = difference from overall of rotation of the

filter to the probe coupled with an.

Ω = Angular velocity of the filter in

rotation/sec.

Centrifugal speed = $(1.5 \times 42.9)\ (2\pi \times 60) = .0600mm/sec.$

dV = average diameter of the smallest areas

$dV = \frac{\Sigma \text{ diameter squared}}{\Sigma \text{ sifted}} = \frac{8.8151.0000}{2.77} = 3.11 \times 10^{-3}$ mm.

SAMPLE CALCULATIONS

Diameter of the average contact area for Tape 8

The statistical analysis of the data for Tape 8 is given in Table XX.

N = number of contacts in one interval

D = the square root of the average of the squares of the two extreme tape distances for one interval

$\bar{D}$ = the square root of the average of the squares of all the tape distances

$\bar{D}^2 = \Sigma(ND^2)/\Sigma N$

$\bar{D}/2 = \sqrt{\Sigma[N(D/2)^2]/\Sigma N} = \sqrt{16238/353} = 6.80\text{mm}$

d_A = diameter of the average contact area

$$d_A = \frac{\bar{D} \times (\text{crossing speed})}{2 \times (\text{tape speed})} = \frac{6.80(.8867)}{100} = 5.90 \times 10^{-4}\text{cm}$$

Basic Definitions

Diameter of the circle contact area for type B

the statistical analysis of the data for type B

is given in Table XX.

n = number of centers in one interval

s = the square root of the average of the squares of the

two extreme type differences for one interval

$\bar{s}$ = the square root of the average of the squares of all

the data differences

$$D_B = \Sigma(s_n)/\Sigma n$$

$$\bar{s} = \sqrt{\Sigma[n(s_n)^2]/\Sigma n} = \sqrt{1028/323} = 1.784$$

d_A = diameter of the circle contact area

$$d_A = \frac{\text{I of the area}}{\text{I of circle area}} = \frac{6.81/.0031}{\pi/4} = 2.80 \times 10^{-3}$$

APPENDIX G

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